Pit and Quarry

SAND - GRAVEL - STONE
CEMENT - LIME - GYPSUM

In This Issue

The first published complete reports of the annual convention of the National Crushed Stone Association just held at Montreal, Can., January 18-21.

The first published complete reports of the annual convention of the National Sand and Gravel Association just held at Atlanta, Ga., January 19-21.

February 1, 1926

Circulation 7,600

KOEHRING Gasoline Shovel

No Complications to Finger-Tip Control

KOEHRING levers can be shifted by your finger tips! The clutches *themselves* shift easily. The advantage is fundamental! There are no mechanical complications to help operators shift clutches that should be easy to shift. Koehring has finger-tip control at the control levers because there is easy operation *at the clutches*—and the operator never loses the important factor of "feeling" the load! And the greater contact surface of the Koehring double outside band self-equalizing friction-clutches proportionately increases the life of the friction. The Koehring shovel offers decisively important, exclusive features of design and construction which directly mean greater adaptability to every situation and condition of shovel operation—greater capacity—and longer service life—to say nothing of Koehring Heavy Duty construction, a vital factor in low operating costs!

Shovel Capacities

No. 1—¾ cu. yd. dipper, struck measure. on 19 ft. 6 in. boom with 16 ft. dipper sticks. 4 cylinder, 5x6 in. gasoline engine, 1100 R.P.M.
No. 2—1⅛ cu. yd. dipper, struck measure, on 20 ft. 7 in. boom, with 16 ft. dipper sticks. 4 cylinder 6x7 in. gasoline engine, 925 R.P.M.

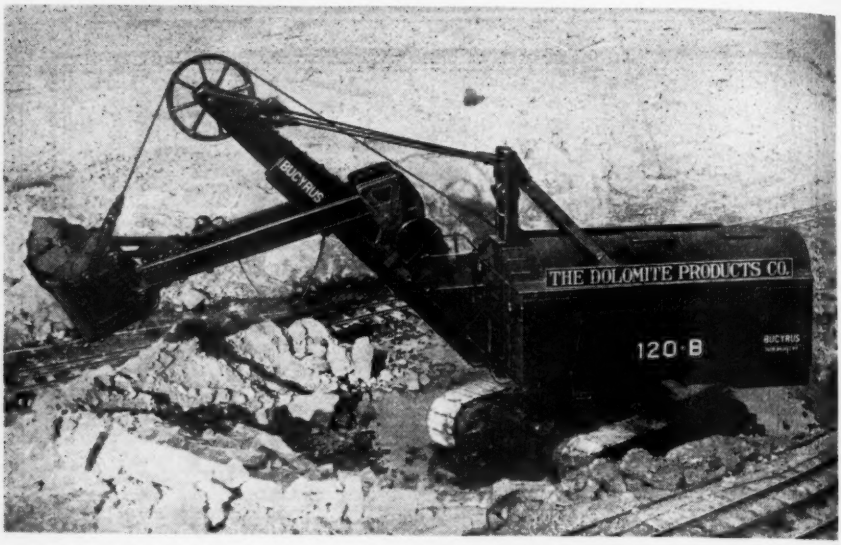
KOEHRING K HEAVY DUTY

Write for Shovel Bulletin No. S.32.

KOEHRING COMPANY
PAVERS, MIXERS—GASOLINE SHOVELS, CRANES AND DRAGLINES
MILWAUKEE, WISCONSIN
A2681-III-IV

Sales Offices and Service Warehouses in all principal cities.

Foreign Department,
Room 1370, 50 Church St., New York City
Canada, Koehring Company of Canada, Ltd., 105 Front St., East, Toronto, Ontario
Mexico, F. S. Lapum, Cinco De Mayo 21, Mexico, D. F.



They Bought This 120-B

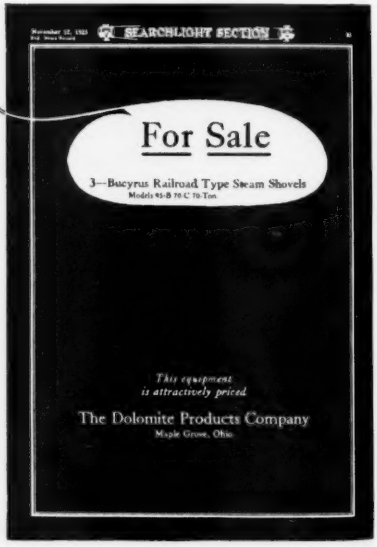
The Result

The Reasons:

The Bucyrus 120-B is a 4-yard full revolving shovel for mines and quarries. It is revolutionizing the digging of ore and rock because it combines in one machine

1—The speed of action of the railroad-type shovel.
2—The mobility of single truck caterpillars.
3—The Full Revolving Swing.
4—Big Dipper Capacity—4 cubic yards.
5—Ruggedness and Power greater even than the railroad-type shovel.

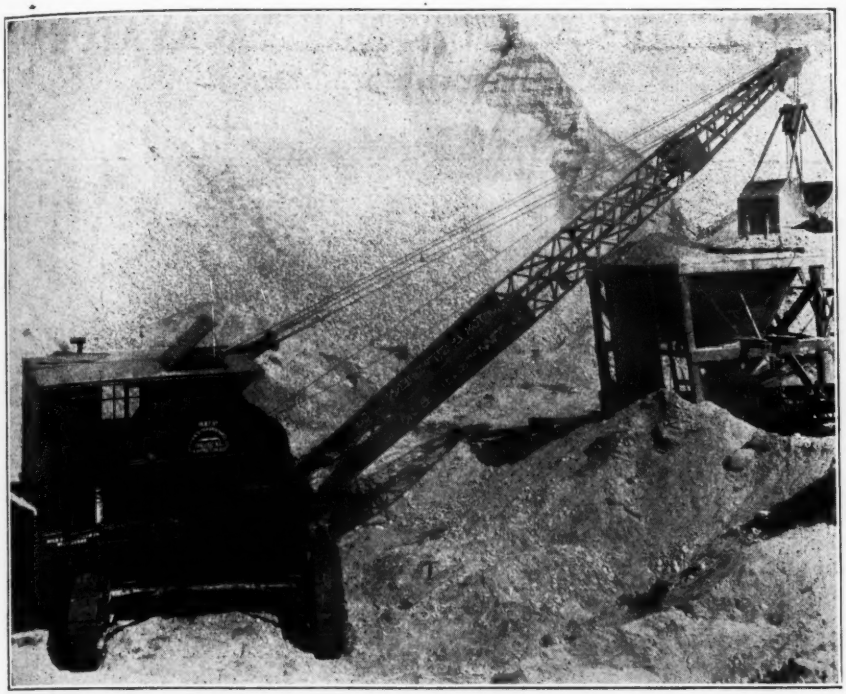
Better investigate. Send for Bulletin D-1202-A.



Bucyrus Company, South Milwaukee, Wisconsin

BUCYRUS

NEW YORK CHICAGO BIRMINGHAM SAN FRANCISCO PITTSBURGH TOKYO LONDON



1000 yards of gravel in 8 hours

with an ORTON Crane

800 to 1000 yards in 8 hours is an average day's work for the ORTON Model "E"—1 yard crane.

It handles a 1 yard clamshell on a 40 foot boom. Just the thing for loading cars or hoppers.

The ORTON Model "E" can be quickly converted into a 1 yard dragline or shovel.

We equip the Model "E" with an 83 H.P. Climax Gas Engine and it won't stall under the toughest digging.

Send for specifications and prices

ORTON & STEINBRENNER CO.

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CHICAGO, ILL.

Sealed Sleeve Bearings

Now on Westinghouse Motors

PRACTICALLY every mechanical engineer knows the advantages of the sleeve bearing; how the larger bearing surface makes for longer life; how sleeve bearings utilize a film of oil for cushioning protection; and why sleeve bearings never cause unexpected shutdowns because of sudden breakdowns.

In Westinghouse *Sealed Sleeve* Bearings those advantages have been made doubly sure. An absolutely air tight housing keeps dust and grit *out* of the bearing and all oil *in* the bearing, thus eliminating the chief cause of insulation troubles. The oil cannot spread to the insulation.

In developing this *Sealed Sleeve* Bearing Westinghouse has again demonstrated its capacity to perfect and apply principles of proved superiority.

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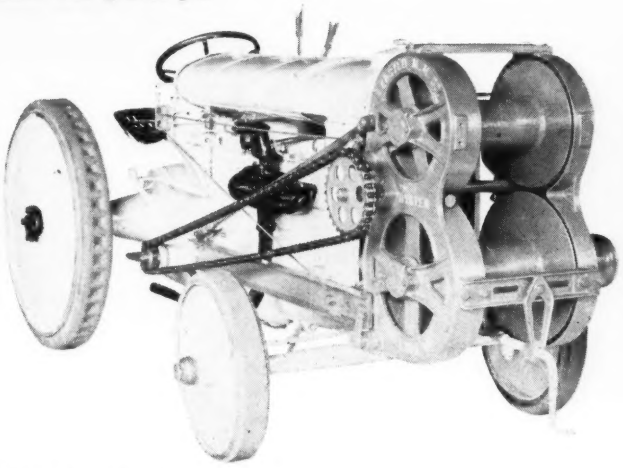
WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
EAST PITTSBURGH · PENNSYLVANIA
Sales Offices in all Principal Cities of the United States and Foreign Countries

Westinghouse

Operating ½ cu. yd. dragline scraper in sand and gravel pit.

ERSTED
"The Hyster"
FOR ANY LIFT OR PULL

A 20 H.P. Automotive Hoisting Engine. 5000 Pounds Pull Capacity.



More than 3,000 in use.

A remarkable hoisting engine, a time saver and money maker in every industry, surprisingly low priced.

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Ersted Machinery Manufacturing Co.
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PORTLAND OREGON

Hayward Buckets

For handling aggregates
—at the source or on the job

Expecting economical results and getting them is one of the profitable advantages of using Hayward Buckets—an advantage that has made the name Hayward on a bucket the accepted emblem of grab bucket economy.

Rock producers, sand and gravel miners, aggregate dealers, contractors—all have proved the merits of Haywards for meeting all handling requirements in each step of aggregate distribution.

Hayward Engineers are always glad to show you photographs and supply data, bulletins and special information that will erase every doubt from your mind concerning the economical adaptation of Hayward Buckets to any digging or re-handling work you may have.

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54-56 Church St., New York, N. Y.

Electric Motor Buckets

Clam Shell Buckets

Orange Peel Buckets

Drag Scraper Buckets

Counterweight Drums

Automatic Take-Up Reels

Skid Excavators and Dredges

HAYWARD BUCKETS
TRADE HAYCO MARK

A SUCCESSFUL Wisconsin Gravel Plant-TELSMITH EQUIPPED

Today Frank Doherty of Milwaukee is a veteran gravel plant operator. He has operated two plants for three seasons—developing four different pits—successfully. But in 1922 he frankly told Telsmith engineers: "I don't know anything about the gravel plant game; but I have a pit at Okauchee; and I'm going to develop it. Figure out what I need. I'll take your word for it."

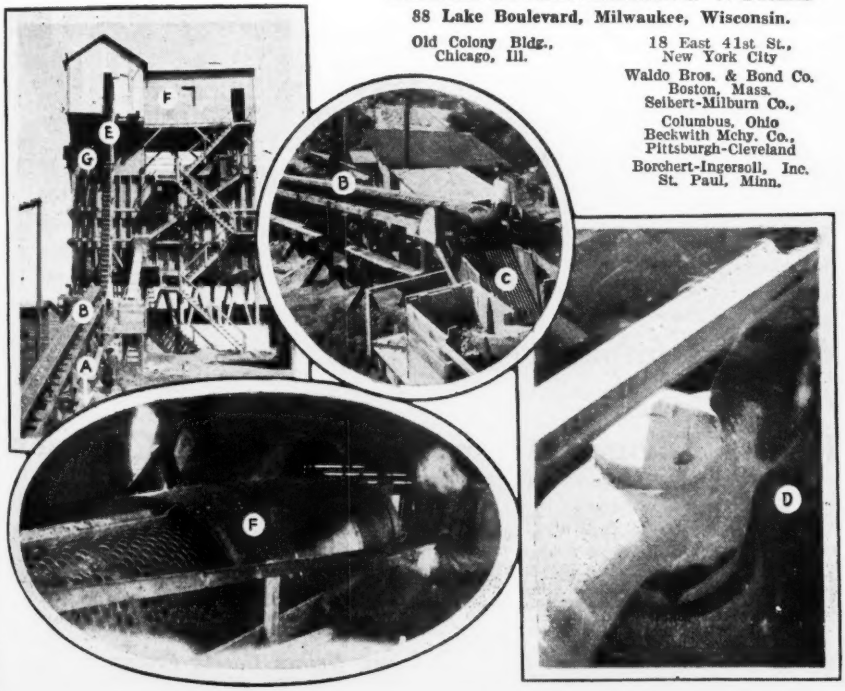
Telsmith engineers sized up the pit; designed the plant; built the machinery and guaranteed it for a capacity of 50 cu. yds. hourly. The plant was started in July, 1923; has been running ever since and has paid for itself handsomely. Today the equipment is still in fine shape. **What more could you ask for any outfit?**

Expert service and centralized responsibility are the factors that make possible such a smooth, short, but profitable story—a plant designed, built and guaranteed by one concern of ample responsibility and pioneer experience.

Pictures show Doherty's equipment: (A) Telsmith Plate Feeder, 24 in. by 5 ft.; (B) 24 in. by 100 ft. Telsmith Belt Conveyor; (C) Telsmith Arrowhead Grizzly; (D) Telsmith Primary Breaker, 10 in. opening, capacity 28-40 tons hourly; (E) No. 5 Telsmith Belt Elevator 60′ centers; (F) Telsmith Washing Screen, 40 in. by 14 ft. long; (G) Telsmith Sand Tank.

Let us size up your gravel plant needs. Glad to send you Bulletin G. P. 15.

G. P. No. 1



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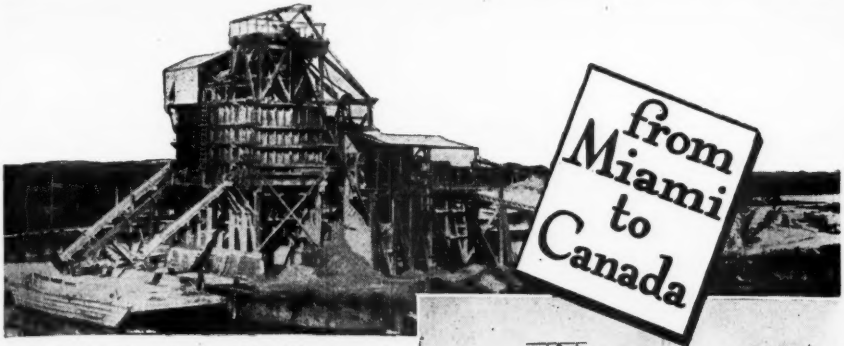

Good Roads Champion Crushing Plant owned by Geo. H. Palmer Co., Miami, Fla.

Complete Good Roads Champion Crushing Plant, owned and operated by Brantford Sand & Gravel Co., Brantford, Ont.

Everywhere—Increasing Profits for Quarries

CHECK up on the most successful rock crushing plants in any section on the continent! Wherever you go, you'll find a good proportion of the plants that are making a real net profit have Good Roads equipment—crushers, elevators, screens, conveyors—everything.

You'll find, too, a good many of the money-making plants have been laid out, built, and equipped from start to finish by Good Roads Engineering service. Undivided responsibility *pays*.

Write for Crusher Catalog K. A. U. or Sand and Gravel Catalog 5-A

Here's the No. 16 Good Roads Champion Crusher used in Miami plant picturedabove.

The GOOD ROADS MACHINERY CO., Inc.
Kennett Square, Penna.
Service and delivery branches in principal cities

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Ohio Gravel Ballast Co., Cleves, Ohio

Enduring Satisfaction with Webster Material Handling Equipment

When you provide Webster Material Handling Equipment for your plant you get a service of known value. You are not speculating on unusual, untried construction features of questionable durability and operation.

For over a quarter of a century Webster Material Handling Equipment has made good in large and small operations. Mechanically correct in design and dependable in operation, built for years of hard service—that means lasting satisfaction.

Webster engineers will gladly consult with you on your handling problems.

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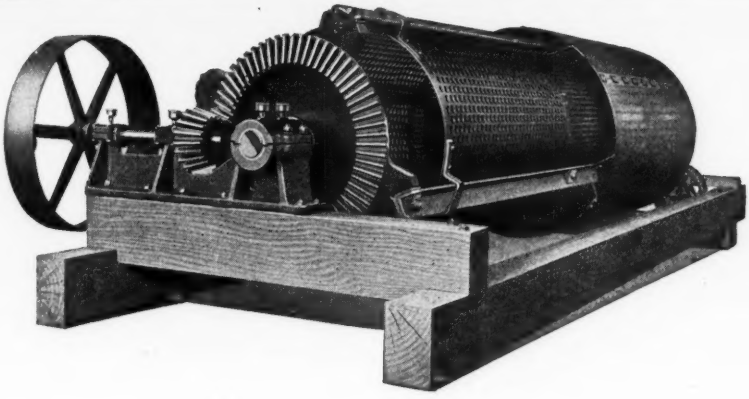

TOEPFER Products

Every Toepfer Product used in the Sand, Gravel and Crushed Stone industry, is backed by the Toepfer reputation for knowledge of how to build them right: —whether it is Revolving Screens, Scrubbers, Elevators, Feeders, Grizzlys, Conveyors, Bin Gates, or Perforated Metals. We have a new catalog which we should like to send you.

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Broadway and Menominee St.

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THERE is strength in the jaws of Owen Buckets. They are built that way, for we know a bucket must perform hard work efficiently day after day, despite the rough usage which buckets cannot escape.

Maybe you should be watchful with some buckets, but you can be careless with Owens. Give them the toughest digging jobs in all of your work . . . use them where durability must be proven by actual accomplishment—where quickness counts in excavating and in moving materials . . . give them a job where heaping loads have been rare. That's the best way of all to test Owens. You'll see something, then.

Because there's strength in the jaws of an Owen Bucket—it is built that way—and like the ancient triceratops of tremendous power, it gets A Mouthful At Every Bite, every time, in any material, until the job is finished.

Besides STRENGTH there are nine points of superiority in Owens—nine reasons why you should use them. A post card will bring you all the details and no obligation whatever.

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OWEN CLAMSHELL BUCKETS INSURE A BIGGER DAY'S WORK

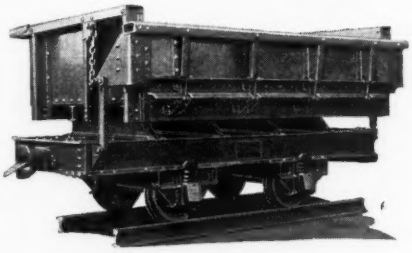
Owen Buckets

INSURE A BIGGER DAY'S WORK

C.O.B.Co.

EASTON QUARRY CARS

Designed by EASTON

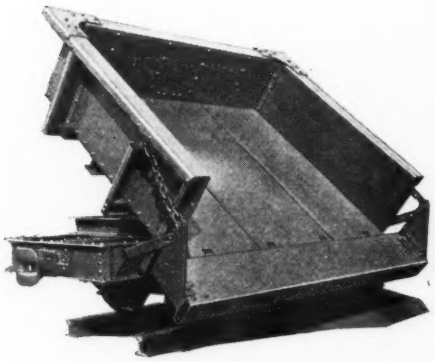


The first WONWAY car was built by Easton three years ago. The New WONWAY car retains our original body and frame design. But we have substituted a simple link to control the doors, and no longer use the cable sliding over rough castings.

WON WAY CAR

ADVANTAGES

Power Dump
Dumping Angle 45°
Door automatically drops
Giving clear discharge
Links close door
As body comes to rest
Low over all height
No swaying in transit
Eliminates derailments
Body perfectly supported
All steel Indestructible



EASTON CAR & CONSTRUCTION CO.

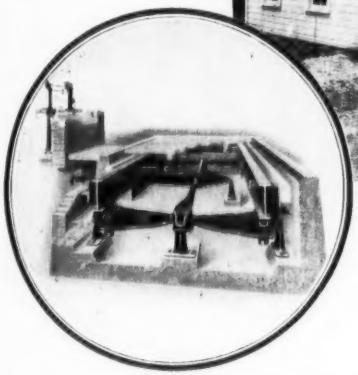
Kansas City, Mo., and Easton, Pa.

New York Chicago Pittsburgh Philadelphia San Francisco

EASTON CARS

FOR EVERY PIT MINE & QUARRY

The Type "S" Scale can be quickly installed. The rugged railway-track-scale type of construction assures long-time, dependable service at low cost



What can you afford to invest in scales?

In putting in scale equipment for weighing truck loads you are making an investment from which you will expect dependable service for a long period of time. The initial accuracy of the scale you may take for granted—but it is important to consider whether the scale will give long-time accurate, reliable and *adequate* service.

It pays to make sure that the scale you install has stand-up ability to meet *your* requirements. To know that it was built from the outset for these conditions—and that in actual service under *similar* conditions, it has proved its case.

The established name "Fairbanks" on an auto truck scale means that the scale has been built throughout for this type of duty. The heavy stresses of auto truck weighing have been fully provided for. The constant impacts, the uneven load, the more strenuous use—these conditions are fully met in the Fairbanks Type "S" Auto Truck Scale by basic design that assures long-lived accuracy and usefulness. In construction this scale is patterned after the famous Fairbanks Railway Truck Scale. It is extremely rugged, yet so finely and accurately built in the vital parts that permanent sensitiveness is the result.

You will find that the investment in a Fairbanks Type "S" Scale—extremely moderate considering the fine quality and construction—is practically the lifetime cost. Write for our bulletin fully describing this scale. Address Dept. SB-2.

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Free Service to our readers

For the convenience of readers who are in the market for equipment, our "Free Service" department will furnish on request any information, catalogs and prices on any machinery, equipment or supplies used in pits and quarries. The coupon below makes it easy for you. Simply check, sign and mail.

Pit & Quarry, Rand McNally Bldg., Chicago, Ill.

Pit and Quarry, Research Department,
Rand McNally Bldg., Chicago, Ill.

WE ARE IN THE MARKET for the items checked below, and would be glad to receive catalogs. prices or other information.

- ☐ Agitators
- ☐ Air Compressors
- ☐ Air Compressors, Portable
- ☐ Babbitt Metal
- ☐ Baffles
- ☐ Bag Filling Machines
- ☐ Bag Sewing Mach.
- ☐ Bags, Cotton
- ☐ Bags, Paper
- ☐ Ball Mills
- ☐ Barges
- ☐ Barrels, Steel
- ☐ Belt Fasteners
- ☐ Belting, Conveyor
- ☐ Belting, Transmission
- ☐ Bin Gates
- ☐ Bins, Clay Tile Storage
- ☐ Bins, Concrete Storage
- ☐ Bins, Steel Storage
- ☐ Blasting Fuses
- ☐ Blasting Powder
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- ☐ Boiler Skimmers
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- ☐ Buckets, Grab
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- ☐ Burners, Oil
- ☐ Cable Coatings
- ☐ Cableways
- ☐ Car Movers
- ☐ Car Pullers
- ☐ Car Replacers
- ☐ Car Wheels
- ☐ Cars, Bottom Dump (Gauge .....in.)
- ☐ Cars, End Dump (Gauge .....in.)
- ☐ Cars, Side Dump (Gauge .....in.)
- ☐ Cars, Steel Gondola
- ☐ Castings, Special Metal
- ☐ Chain Drive
- ☐ Chain, Conveyor
- ☐ Chain, Steam Shovel and Dredge
- ☐ Chaser Mills
- ☐ Chutes and Liners, Metal
- ☐ Classifiers
- ☐ Clips, Wire Rope
- ☐ Clutches
- ☐ Controllers, Electric
- ☐ Conveyor Equipment
- ☐ Conveyor Rollers
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- ☐ Cranes, Locomotive
- ☐ Cranes, Traction
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- ☐ Crushers, Disc
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- ☐ Crushers, Hammer
- ☐ Crushers, Jaw
- ☐ Crushers, Roll
- ☐ Derrick Swingers
- ☐ Derricks
- ☐ Dippers
- ☐ Draglines, Cableway
- ☐ Draglines, Revolving Boom
- ☐ Dragline, Scraper

(*Continued on next page*)

- ☐ Dredges, Dipper
- ☐ Dredges, Land
- ☐ Dredges, Sand Suction
- ☐ Drill Steel
- ☐ Drilling Contractors
- ☐ Drill Sharpening Machines
- ☐ Drills, Blast Hole
- ☐ Drills, Hand Hammer
- ☐ Drills, Tripod
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- ☐ Dry Pans
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- ☐ Dynamos, Electric
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- ☐ Engines, Gasoline Portable Power Unit (H. P.....)
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- ☐ Motors, Gasoline (H. P.....)
- ☐ Motors, Gasoline Portable Power Unit (H. P.....)
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- ☐ Pumps, Dredging
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- ☐ Scales, Track
- ☐ Scrapers, Power
- ☐ Scrapers, Team
- ☐ Screening Equipment

(See other side)

- ☐ Screens, Perforated Metal
- ☐ Screens, Rotary
- ☐ Screens, Vibrating
- ☐ Separators, Air
- ☐ Separators, Gypsum
- ☐ Separators, Magnetic
- ☐ Separators, Sand
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- ☐ Shovels, Electric (.....yd.)
- ☐ Shovels, Gasoline (.....yd.)
- ☐ Shovels, Steam (.....yd.)
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- ☐ Steel, High Speed
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- ☐ Steel, Structural
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- ☐ Unloaders, Bin
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- ☐ Unloaders, Conveyor
- ☐ Wagons, Dump
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- ☐ Welding Equipment
- ☐ Winches
- ☐ Wire Cloth

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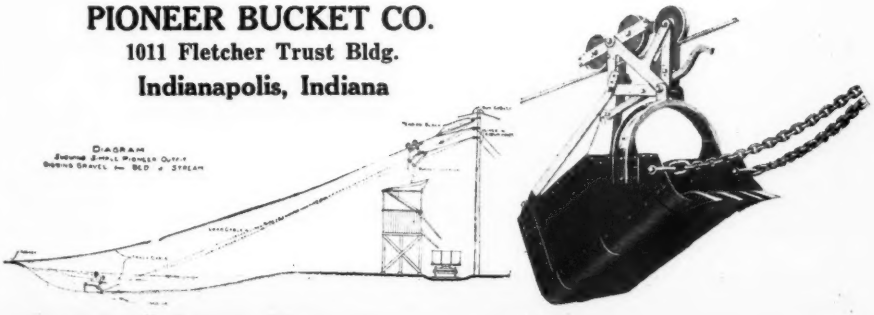
Pioneer
Back-Dump Bucket

Before placing your order for your gravel handling equipment, send for our new Pioneer Catalog

PIONEER BUCKET CO.
1011 Fletcher Trust Bldg.
Indianapolis, Indiana



Pit and Quarry

Index to Advertisers

Vol. 11 CHICAGO, ILL., FEBRUARY 1, 1926 No. 9

Pit and Quarry

A Semi-Monthly Publication for Producers and Manufacturers of Sand, Gravel, Stone, Cement, Gypsum, Lime and Other Non-Metallic Minerals.

Subscription price $5.00 per year. Single copies 25c.

Vol. 11 CHICAGO, ILL., FEBRUARY 1, 1926 No. 9

FEATURE CONTENTS

Pass it on

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Engineer

Supt.

Foreman

Purch. Agent

COMPLETE SERVICE PUBLISHING CO.
Rand-McNally Bldg., Chicago, Ill.

Publishers of

PIT AND QUARRY and Pit and Quarry HANDBOOK

Pit and Quarry

Vol. 11 Chicago, Ill., February 1, 1926 No. 9

Leaders in the Crushed Stone Industry Take Inventory at Montreal

PROBABLY no previous convention can boast of as many distinctive features for those interested as can the Ninth Annual Convention of the National Crushed Stone Association which was held in Montreal from January 18th through January 21st. The attendance was large, the membership of the association having practically doubled. That the program interested the members can be attested to by the fact that the sessions were especially well attended and the program carried out on schedule. The new bureau of engineering was launched on a cooperative basis with the approval of all in attendance. The interest of those present was reflected in the unusual desire to discuss the basic problems of the industry.

The outstanding feature of the convention was the new engineering bureau and the service which it will render the user of crushed stone. Mr. Goldbeck's report on the proposed research work of the association was unanimously endorsed, and the discussion showed clearly that the members have agreed to the basic principle of rendering service to the consumer.

Some other interesting features of the convention were the organization of an effective administrative directorate with Mr. Otho M. Graves reelected as president; the development of a greater interest in the sessions of the convention; an agreement on a closer contact on problems of common interest; and the inauguration of plans for developing a greater association during the coming year. The convention was proof that a vigorous membership campaign will show results.

The convention was formerly opened by the president, Mr. Otho M. Graves, at 10 o'clock on Monday morning, January 18th. Mayor Duquette of Montreal was introduced and welcomed the convention to the city. With a cordial friendliness he presented the city to the crushed stone producers.

Mr. Graves presented an informal review of the year's activities and the changes in policy of the association in his address. The following extracts from Mr. Graves' address indicate clearly the position which he takes in relation to the bureau of engineering. This position reflects also the attitude of the membership as the subsequent proceedings developed.

"Our attention should not be concentrated upon ourselves, not what we are going to get, not what we are going to obtain for ourselves, but that we continually hold in our minds the idea that the function of the individual or of the nation is to serve. If we have not this idea continually before us, I think an eternal oblivion awaits us.

"The only way I believe this Association or this industry can grow and prosper is by forgetting the desire to prosper, by remembering only there is a distinct obligation on every producer of crushed stone to serve the market as he finds it or as he makes it, in the most efficient and effective manner. It is true, of course, and it is not improper to recognize it, that as a by-product of such effort prosperity always follows, but it must come as a by-product. Every man and every company should endeavor sincerely to examine his or its own conscience in order that he or it may better serve those world interests, as may be required, in an effort to get in the scheme of eternal existence as it is before us. If we do not make that effort the future is not particularly roseate. Now, I think this Association is doing exactly that thing.

"The Bureau of Engineering must seek to serve the users of our material, and not seek to serve us. I believe as firmly as I believe I am standing on this platform that if the

Otho M. Graves
Reelected President N. C. S. A.

Bureau does exactly this, efficiently, effectively and sympathetically, and devotes itself to serving the interests of the users of our product, it could not in any conceivable way better serve our own interests.

"If there is any doubt in the mind of anyone that we should start a propaganda and throw the slogan across the country that "stone is best by every test" regardless of what other interests may be, now is the time for us to discuss it. I do not believe in those suppressed thoughts or suppressed desires. It is by talking we get ideas. No man objects to another differing from him frankly and openly. I think you are in sympathy with the idea, but I can only tell your opinion as Mr. Goldbeck, the Board of Directors and I get the reaction from it.

"I do not want to be misunderstood. I believe the association should serve the industry, and I think we all feel the same in this respect. We want our industry to prosper, because it is natural and human. We are not going to be so idealistic that we will not keep both feet on the ground. At the same time I believe the best way of serving ourselves is to serve the user of our material. The motive for what we do as to serving the user of any material should not be that because by so doing we ourselves will prosper, but because it is the right thing to do. It is right to serve the user of our product, and if we can do it in the clean conscientious way through our Bureau, I think good which will always follow in the train of the right line of action will unquestionably accrue to us.

"In the first place, the Bureau of Engineering is susceptible of greater development than is yet planned. I think it is always helpful to dream dreams and to hold ideals, even if they do not always materialize, and I would like to see the Association holding certain ideals and looking forward to practical development, even if we do not ever get there.

"I am particularly interested in wishing that sometime in the not very distant future it will be possible for the Bureau of Engineering to conduct itself certain preliminary tests, not with the thought particularly that we are going to test various matters and put them out as our findings, because I know the objection to that fully as well as you do. We have, however, in Mr. Goldbeck a man who has all his life concerned himself with matters appertaining to testing material, and who is recognized as an authority on the subject. Thoughts and queries occur to his mind all the time, and possibly he wonders a bit, as to what would happen if you did this, or did that, or did something else. I think he should be equipped to start certain preliminary investigations. I refer particularly, of course, to road design and the testing of materials as they enter into road construction. He should have sufficient equipment and facility to start certain investigations, and if he finds there is anything in the matter investigated he could go to an established Testing Society or to any of the Boards at Washington and say: 'I have gone thus far, and these are my findings. Are they not of sufficient interest to you to take the matter up and carry it further?' I think it is well worth our while seriously considering the proposition."

The reports of the various directors on business conditions during 1925 and the outlook for 1926 developed some facts of great interest. We have quoted liberally from the various speakers and have selected statements which are distinctly of interest.

C. M. Doolittle said:

"The merit of rock ballast is making steady progress in Canada. Three of our principal railways have adopted rock ballast as their standard for main

lines. The only important railway which has not adopted crushed stone as standard for ballast is the Canadian National. With them it has been a question of finance. With the wonderfully increased earnings in 1925 we are assured that their budget will include rock ballast for 1926.

"A re-organization of the Highway system of Ontario has been worked out by the Provincial Department, whereby each Township and County will know just what roads they are responsible for, and what roads will fall under the care of the Provincial authorities. This is a great step forward, allotting responsibility and enabling each to plan their work systematically in advance.

"Investigation has shown the perils in the use of any other aggregate than clean, crushed stone, properly sized, for use in our concrete highways. This fact, as it becomes widely known, cannot help but bring an increase in business to the industry.

"Building in Canada during 1925 reflects in a remarkable way the general business conditions under which we have been working for the past twelve months. We have witnessed marked fluctuations from month to month, and spasmodic flurries of activity have been followed by periods of depression. The final record shows an increase in total volume of 7.8 per cent. The industrial section shows the greatest gain.

"During 1925 building permits amounted to $552,000,000. Of this total $331,000,000 has been completed. This leaves a carry over into 1926 of $221,000,000 to be expended on construction work.

"The use of Agricultural Lime is still in the pioneer stages in Canada. The Provincial Department of Agriculture is advocating the use of lime, An Alfalfa Campaign is now under way, which will mean the increased use of lime. Through the efforts of the Agricultural Enquiry Committee of the Provincial Legislature the railways gave a voluntary reduction in freight rates on agricultural limestone. Much missionary work still remains to be done, but we have had an encouraging increase in tonnage in 1925, and look forward to better business in 1926.

"The year 1925 marks the definite reversal of the business trend which has prevailed throughout Canada since 1920. Following the after-war boom which collapsed in 1920, Canada has had a period of liquidation. The result of this liquidation, now completed, is that business in Canada is probably on a sounder and firmer foundation at the present time than has been the case in the last fifteen years."

A. T. Goldbeck.
Head Bureau of Engineering N. C. S. A.

F. W. Schmidt said:

"On account of favorable weather conditions in the spring of 1925 operations commenced about two weeks earlier than usual. During the months of April, May and June, production and sales ran about 10 per cent ahead of the previous couple of years. Through the summer demand and production seemed to average about normal. In October, which is usually our best month, demand and production decreased very materially, due entirely to weather conditions prevailing in the late fall.

"The general demand for crushed stone for concrete purposes throughout the state of New Jersey was greatly reduced on account of the use of gravel for road work; the State Highway specification in New Jersey placing gravel and crushed stone on the same basis.

"There was a normal demand for mineral aggregates throughout the state, but in some localities the crushed stone producers could not meet the gravel competition, consequently their operation was greatly curtailed.

"From the present outlook it would seem as if there will be fully as much mineral aggregate used in road construction during 1926 as in 1925.

"Whether this business will go to the crushed stone or the gravel people will depend entirely upon competitive conditions. If the freight rates are the same, the gravel people will get it. If there is difference enough in the freight to make up the difference between the selling price of stone and gravel, the stone people will have an opportunity."

W. Scott Eames said:

"During the past year in New England, in the early spring the stone producers found business starting very slowly. It did not start with the force and snap that it had in previous years. In June we saw a marked improvement, as a large volume of business was opened up at that time. In New York City and in New England, the volume increased, and this continued into the summer. In August it fell off; and then increased again with a rush that lasted through the fall months, and matched the large volume of previous years.

"The railroad company in the past year gave us very efficient and prompt service. We had no delays in car equipment for shipments. They made every endeavor to work and cooperate with us.

"In New England the specifications of the different states for sizes of stone vary. We have to be very careful to meet the requirements of the different engineers of the Highway Departments.

"The price for stone in New England for the quality and grade that we produce is 25 per cent lower than the price for stone produced in other parts of the country. This is a serious situation for the producers of New England, and to meet this we have to have the most modern and efficient machinery that can be obtained, and we have to maintain a high standard of workmanship at our plants to keep the plants running constantly and efficiently. A large serious break-down is very costly to the producers when it takes several days to take care of accidents of this kind to get the plant in operation again.

"This year we have already a large volume of orders placed with us. With orders we already have and what we had in sight we feel that one of the most remarkable years in the stone industry in New England is before us.

"The labor situation in 1925 was much easier than in previous years. With a much increased volume of business for 1926 it is felt that there will not be sufficient labor to go around. How serious this is will be determined on the work that is started this year.

"The only cloud that I can see now is the change in the security market. With the changing of the present Income Tax Law the present sur-tax is reduced one-half to allow the investors of this country to place their money in other securities where the interest is much larger, in preference to the present tax exempt bonds which have been issued by the different States, Counties and Cities. These bonds, I am fearful, will not find such a ready market as previously. They will not sell as readily as before and will not secure the premiums previously obtained for such a high grade class of bond. This will bring about, I am sure, a curtailment of public works, as the different cities will not be able to sell readily this class of tax exempt bonds to obtain funds. How serious this will be is a matter that will have to be determined after the new Income Tax becomes a law. It has already passed the present Congress."

E. J. Krause said:

"Central and Southern Illinois business conditions for 1925 have been fairly good, and a fair volume of stone has moved. One notable point of interest is the tremendous increase in the use of agricultural limestone. The tonnage for 1925 was 750,000 tons, and I believe 900,000 or perhaps 1,000,000 tons would have been used had it been available. Practically for the first time in the history of the crushed stone industry there is a market for the quarter inch size. Labor has been satisfied, and transportation has been good.

"The outlook for 1926 is good, with one exception; we believe our hard road program will start a little late because there is some conflict of opinion regarding the law."

John Rice said:

"The territory which comes within the range of my observation and knowledge is Southern New Hampshire, Southern Maine, Northeastern Massachusetts, Western and Central New York, Northern and Eastern Pennsylvania, Southern New Jersey, Delaware, and Eastern Maryland.

"I think I may well say that never before 1925 in the experience of my company has business generally been

of a more substantial character throughout the entire territory and consistent throughout the season. The supply was fairly adequate to the demand, and when we experienced some shortage in our own supply some of our neighbors very kindly came to our assistance and tided us over a few peaks, which was helpful to us, and I hope also to them.

"As a mere observation, which may not be inapropos, it seems unfortunate that some bright outstanding intellect in Congress cannot devise some modification of the Sherman Law by which there can be some real cooperation among competing producers in the matter of price, production, and distribution without an infraction of the law. The Sherman Act is founded on the theory that competition being the life of trade competitors will scramble for prospective business with all the eagerness of two dogs after one bone, with the hope or thought that in some way the public is likely to be benefited by minimum prices. This simply results in the survival of the fittest. If perchance two competitors happen to be friendly, even if their desire be merely to observe the Golden Rule as between themselves and even as they may jointly view the consumer, they immediately come in conflict with the law. If we observe the higher law Heaven may be our reward, but it may also be through the portals of the jail. The ultimate solution may be something like a combination or cooperation under Government supervision in which publicity of accounting and costs may be a factor in the process.

"As far as 1926 is concerned, I see no cause for concern. There is every reason to believe that business generally is going to be good. If the long deferred settlement of the anthracite coal strike be satisfactorily accomplished, about the only cloud existing will be dissipated. I am further inclined to believe that the crushed stone industry itself may enjoy a prolonged prosperity because of my faith in the continuance of highway construction, which consumes so large a portion of our product, and my belief in this is founded on the fact that the present motor car licenses and gasoline taxes are adequate to bear the expenses of maintenance and amortize the cost of construction. Since there seems to be no opposition to this form of taxation on the part of the motorists, and they are a very substantial and influential portion of the electorate, there is little objection to be expected from other parties, and, therefore, in my opinion road building will proceed enthusiastically for a good many years to come, notwithstanding the fact that the annual expenditure runs into billions of dollars in the United States.

W. L. Sporborg said:

"Speaking for the State of New York, the area away from the City of New York, business conditions during 1925 were quite reasonably good and satisfactory to the producers, who have done fairly well. The start of the season was a little late, but the tonnage produced up to September 1st was ahead of the year 1924. Then there came a good deal of rainy weather, which set the producers back in their prepared tonnage. Weather conditions during the end of the season were, however, such that they caught up, and in most cases the tonnage was about the same in 1925 as in 1924.

"The level of prices was about the same. In a part of the area there was a slight movement of prices, but for the greater part prices were about the same, and costs were about the same. Labor was adequate both for the users and for ourselves.

"The spirit of cooperation and the character of the competition which exists among the producers are such that they tend to build up the industry, and establish a satisfactory, profitable and permanent condition.

"Some concern is felt for the year 1926, because of the conditions in the building industry, on two points. It appears that building has about caught up on such slack or deficit from the time of the war, and it seems building is slowing down somewhat; but residence construction nowadays tends to the suburbs and outlying districts, and as new subdivisions develop the area of centers of population is becoming greater, and so far as city pavement is concerned this makes business for our commodity. It seems likely the crushed stone required for the laying of city pavements will equal and probably pass the quantity of crushed stone required in building construction. Personally I see no ground for fear of a reduction in the demand through the catching up of the building industry.

"There is a disquieting attitude in the building industry, and it appears possible that the building contractors and building labor are about to lock horns for a finish fight. Whether this

is the fact, time only will tell. However, it does not look very good.

"The State of New York in our area spends about $35,000,000 on highway construction each year, which it appropriates from current funds. Supplementary to that there is a considerable expenditure by the Counties and the smaller municipalities, villages, towns and cities, and there is every reason to believe the crushed stone industry has before it the necessity of supplying the requirements of a permanent demand, probably increasing but certainly (in my opinion) not lessening, for highway work. Highway work has become the greatest single user of our commodity.

"The railroads use a uniform quantity of ballast, and they are prosperous and have been able to render us excellent transportation.

"I see no reason why the crushed stone industry in the territory I know of is not facing a permanent future of assured business."

H. Landa said:

"The quarries in Texas have been reasonably busy last year. The only difficulty we have found was in delivery to the railroads. They have been somewhat short of help on account of the very large cotton crop. They depend to a large extent upon Mexican labor, which, of course, migrates to the cotton fields in the fall.

"I think we are facing a year of prosperity, judging from our own plant. We have already booked orders for 1926 about 100 per cent in excess of our entire business of last year."

R. B. Tyler said:

"There are very few large crushed stone plants in the State of Kentucky, on account of the fact that Kentucky is considered a limestone state, and good commercial limestone can be found in nearly every County in the State. In practically all of the road contracts that are let by the State Highway Department for the construction of highways, there are found one or two good quarry sites, right alongside the roadway, where local quarries (what we call "roadside quarries") can be opened up to advantage, thereby saving the expense of freight and hauling of the crushed stone macadam for the roadway. For this reason the few larger plants in the State of Kentucky which are located on the railroads have to rely mostly on railroad ballast, and then selling the balance, or what they can, to contractors on highway projects, or to small cities and counties which use a few cars of crushed stone. The railroad companies have not been using their full quota this year, using about 50 per cent of their normal supply.

"On account of our State Highway Department running into debt during the previous year, and exceeding their apportionment for highway work, it was necessary to curb their expenditures for this past year, and they have had practically no funds during 1925 for entering into contracts for State Highway work. Many of the crushed stone producers for this reason have operated their plants only on a 50 per cent basis, and I am sure that 75 per cent of the plants in this State will not show a profit for the year 1925.

"The labor situation during the past year in Kentucky has been good. There has been plenty of labor available, and at reasonable prices, and if the quarries would have had the demand for their products they could have run their plants to full capacity.

"The railway companies have been paying for ballast from 75 to 95 cents a cubic yard. There has been no tendency shown to lower the prices on the small amount of stone used in highway construction, the prices ranging from one dollar to a dollar and a quarter a ton, and if there had been a demand for this stone during the past year, I am sure the stone operators would have shown a good profit.

"In regard to freight rates, the railroad companies have, to a certain extent, regulated the rates, and I have heard no serious complaints from any of the operators about this matter.

"The State of Kentucky will be out of debt the first of July, and the State Department is contemplating letting a large amount of road construction, and I am sure that from now on there will be enough available highway construction to afford a considerable amount of tonnage from the larger plants for this class of work. This, together with the ballast from the railroad companies, should keep the quarries working in the near future nearly up to 100 per cent, and at a profit. Therefore, the prospect for the next year or two in the State of Kentucky, and also several of our other Southern States, is very promising."

O. P. Chamberlain said:

"The Chicago district, where we operate, representing eight stone

quarries, showed about 65 per cent potential capacity of the plants for the year's business. Prices obtained were slightly lower than those obtained in 1923 and 1924, but by carefully selecting the business I think I might say all the plants did a profitable business during the season of 1925.

"In connection with our ability to make deliveries, I feel I should speak of the co-operation we received through the Regional Advisory Board in the providing of cars and in the handling of railroad equipment, in such a manner that our service was almost 100 per cent.

"The production and sale of agricultural limestone during 1925 was very gratifying to the business in our district. From 1921 the agricultural limestone business languished, due, probably, to the inability of the farmers to purchase agricultural limestone. I have personally always felt that the farmers would purchase it if they had the money. They seemed to be in a better position last year, and we did a business far above normal in agricultural limestone. Many of us improved prices and conditions which had prevailed, and upon the whole, we did a very satisfactory agricultural limestone business.

"In regard to the prospects for 1926 we feel our road program is not certain at the present time, as in the State of Illinois any bond issue must be completely obligated before a second bond issue can be drawn upon. We have now an authorized bond issue of one hundred million dollars, succeeding a previous bond issue of fifty million dollars which has not yet been entirely obligated. The highway authorities at Springfield are attempting to set up the contention and to get a Court decision which will establish that where legal proceedings have been started in connection with securing right of way for new roads, and where obstructions of a legal nature have obtained, the expenditure of money in those suits shall constitute a legal obligation of the funds for the work. If the decision is favorable, our road construction will start soon, and in that case conditions in Illinois for 1926 should be certainly as good as those of 1925, and possibly go back to the slightly better conditions which obtained in 1923 and 1924.

"One of the troubles in our district during the last year was the lack of outside work on public roads. Another is due to the aggregates getting into our district at a price which even with the differential in freight rate on our commodity (due to the fact that our product is mined in the switching district of Chicago and the haul is short) the result was we had in some cases to reduce our prices.

"We hope the Agricultural Department will be able to make good its contention as to the obligation of the bond, when the new bond issue will be available soon."

P. B. Reinhold said:

"In rendering a report covering conditions in Western Pennsylvania we have covered that territory from Johnstown to the Ohio State line and from Lake Erie to the West Virginia line. In this section I am pleased to advise that everyone experienced a good year. The vast majority of the stone was, of course, sold to the steel mills, but at the same time crushed stone for highway construction ran a very close second. As near as we can estimate 1½ million tons of stone was sold for flux, and about 800,000 tons of crushed stone for highway construction.

"The Department of Highways of Pennsylvania constructed about 1100 miles of highway during the year. This mileage includes concrete, waterbound and bituminous macadams as well as reconstruction of deteriorated highways. Of this total, approximately 758 miles were of concrete construction. It is interesting also to know that of the entire total mileage of new construction, about 99 per cent, was of the concrete type. As previously stated there was marketed approximately 800,000 tons of roadstone in Western Pennsylvania, covering highway jobs supervised by the Pennsylvania Department of Highways, as against approximately 30,000 tons of slag used in the same type of construction. The 1925 program has indicated 223 miles more than was ever constructed by the Pennsylvania Department of Highways in a single year. We find that from 1911 to 1923, 196 million was spent on State Highway construction. However, of this total, about 150 million was spent from 1919 to 1923. It is estimated that the total expenditures from January 1, 1923, to January 1, 1927, will approximate 220 million. In addition, during these four years about 85 million will be spent on township roads under the general supervision of the Department of High-

ways; making a total expenditure of 305 million under the general supervision of Mr. Connell's Department. This is probably a greater sum than has ever been spent on any engineering project, including the Panama Canal or the New York water works, in the same period of time, and there is no doubt but that just so long as transportation remains on terra firma the highway problem will be increasing from year to year. We hear much of the abandonment of railroads due to competition from truck hauling, and according to statistics from the Bureau of Public Roads we find that on the mileage abandoned since 1920 only 4.3 per cent can be attributed to highway competition. The total trackage abandoned since 1916 is more than 3800 miles.

"As concerns railroad ballast, there are but one or two concerns interested in this business, mainly due to the low price available. The larger of these two has since discontinued operation.

"As concerns the business available for the rock dusting in bituminous coal mines we find that many of the coal operators are installing their own machinery for crushing the local mined slate. This material is, of course, highly silicious and injurious to the miners. Another obstacle in this business is the fact that so many of the coal mines have been closed for months. In spite of the fact of the constant urging of the United States Bureau of Mines that rock dusting be done in all mines, using limestone as the dusting material due to its being free from silica and its illuminating features, nevertheless, many of the operators are not now dusting their mines, which has resulted in serious accidents causing the deaths of over 100 men in the bituminous field.

"The agricultural limestone business was about normal during 1925, but we look forward to increased shipments during 1926.

"The 1926 program for the Department of Highways is not yet completed, and figures are therefore not available. However, from what we can gather, it is the understanding that the program will be approximately the same as 1925 so that the producers in our territory should enjoy equally as good a year as the one just past. It is our understanding that approximately figty-five to sixty million will be available for Department of Highway use. The fluxing stone business is expected to be good.

"Railroad ballast is very questionable, as the railroads will not buy stone for ballast without meeting the slag prices. Agricultural limestone business is expected to be normal, or better.

"For 1926 conditions seem to be secure, but we sincerely hope that after the twelve months have passed we will have been able to get sufficiently high prices, and that the security will not be in the form of first, second, and third mortgages."

W. F. Wise said:

"Our business is good. Transportation was perfect. Troubles in our plants have been very small. With regard to labor, we anticipate about the same condition next year."

The proposed research work of the association was presented by Mr. A. T. Goldbeck, director of the bureau of engineering, at the afternoon session on Monday. This report is given in full here.

"A too vehement declaration of the course one is going to follow or of the results one is going to obtain is sure to react in full measure against successful accomplishment. Great promises seldom materialize in great deeds. At the outset, therefore, I shall try to avoid imposing on myself the burden attendant on high promises and shall be content merely to indicate some of the ways in which the Bureau of Engineering might function, some of the researches it might be able to undertake, and the possible benefits which might accrue to producers of crushed stone.

"In a broad general way research in the crushed stone industry holds potential benefit in certain well marked directions. I realize that your ultimate criterion of success will be the development of your business in the future as contrasted with the past. Primarily you would like to maintain your growth in a manner that will stand favorable comparison with the producers of other aggregates and your Bureau of Engineering fully realizes that its efforts must be directed to that end. If this were the only end, however, if you believed that you alone should receive benefit from the work of your Bureau, the venture would be foredoomed to failure or to only partial success, just as is all purely selfish enterprise. I have faith in a larger and more unselfish viewpoint which you, too, must have had when you originally conceived of the Bureau of Engineering.

Your Bureau holds an attitude of helpfulness not only to the industry, but also to all users of your product. In generous measure we stand ready to aid the using public in any solution of their problems pertaining to stone, and to assist in any practicable manner in the development of better design, better standards of construction and better specifications. These are things which we, as a national body, should contribute to the general good, for in so doing we maintain our respect as a nationally useful organization. Moreover, general helpfulness cannot but redound to our benefit. Friendliness begets friends.

"But you wish to know specifically how we think we might be able to function to good advantage. How can engineering research help you and in what channels should that research be directed? Generally speaking you will be assisted, (1) if ways can be discovered—to produce stone at less cost; (2) if your waste products might all be utilized; (3) by improvement in your product; (4) by improving the design of structures utilizing crushed stone; (5) by supplying the facts which will show the advantages possessed by stone in various types of construction; (6) by service to crushed stone users. Let us consider these six phases in some detail.

1. The More Economical Production of Stone

"A perusal of cost of production records shows a wide range of figures whose divergence is partially due to unavoidable circumstances such as character of rock, location and character of quarry, and many other factors. When I see figures for individual cost items varying widely in plants operating with the same character of rock, and with about the same production, it seems quite probable that investigation directed toward cost reduction holds considerable promise. The Bureau of Engineering can help in this work by acting as a central agency for the instigation of lines of research within the industry at certain plants which seem to lend themselves to the particular problem in hand and which might be benefited thereby. For instance, there seems to be room for further work on the size and location of blast holes as governed by the character of rock and other influences, boulder breaking, loading and delivery, crushing and screening, and no doubt other items. All of these vary widely at present and possibly organized research will show the way to a general reduction in these costs.

"Another item which the Bureau of Engineering should handle is that of screen standardization. Many of you are handicapped by the necessity for supplying more sizes of stone than are actually necessary for the successful performance of construction work. Adjacent states which you are serving often have specifications which vary just enough to make you keep on hand an unnecessarily wide variety of screens. A simplification of sizes and the bringing into being of a national nomenclature for those various sizes would do much toward simplifying the industry and would eliminate confusion. Engineer, contractor, and producer would then all talk of stone sizes in the same terms throughout the country. A start has been made in this direction by the road materials committee of the American Society for Testing Materials. We can help them by having their report given proper consideration by one of our technical committees, or by a special committee appointed for that purpose. After our criticisms have been received by the A. S. T. M., their present tentative standard for commercial sizes of stone will then be proposed as a standard of the Society. The next step might be its proposal to the American Engineering Standards Committee as a national standard. The matter might also be handled through Secretary Hoover's Division of Simplified Practice.

"From what I am able to judge of your present organization, I am convinced that you would do well to appoint more sub-committees to study particular subjects within the industry. The Bureau of Engineering should be active on those committees and, in fact, one of its functions should be to help the committees and keep them at work. We certainly wish to reduce costs of production. Let us start some investigations along well-laid lines, to find out how this can be accomplished.

2. Utilization of Waste Products

(a) Stone Screenings.

"Many of you have on hand and are still accumulating large quantities of material now without a sufficient market. Stone screenings are a burden and their disposal at a profit would decrease the cost of production as a whole. One of the problems, then, is

to fully present the various means by which this material might be used successfully. Some of you have already established concrete products plants for this purpose, others have been successful in disposing of stone screenings for use as a fine aggregate in various forms of concrete construction, used alone or in combination with sand, for use in roofing products and in granolithic floors or sidewalks.

"For developing the use of screenings as a fine aggregate in concrete research holds considerable promise. Researches have already been performed showing that screenings might be used for concrete construction provided they are made from durable rock and are mixed in those proportions which will result in a dense strong concrete. One of the secrets of durable concrete is density with strength, and well-graded fine aggregate is a very important factor in the attainment of high density. The very best results will be obtained from screenings when they are graded in much the same manner as a good grade of concrete sand. As a rule commercial stone screenings are characterized by a large proportion of coarse particles and a large amount of dust with a lack of intermediate particles. A much higher degree of workability in concrete containing screenings would be secured if the screenings were reground and screened to meet concrete sand specifications. A very highly satisfactory product for all kinds of concrete construction would then result. Much investigation should be carried out along this line and the commercial possibility of the preparation of properly graded screenings should be looked into by those plants so located as to make a processed screenings market profitable. The work of the Bureau of Engineering will be to get the necessary research accomplished to demonstrate the possibilities of stone screenings.

"One very important development in connection with the use of screenings has come out of the research work on subgrades of the United States Bureau of Public Roads. Thus, subgrade research shows that roads are very greatly affected by the type of soil upon which they are constructed. In general, these soils which are highly plastic, such as clays, are very apt to give trouble for they take up and hold considerable quantities of water both from below by capillarity and from above. They then become soft and swell in volume considerably and give very poor support to the road. When they dry out they shrink unequally with a resulting unequal support, particularly for the rigid type of road. The more granular soils, on the other hand, give very good results for they drain easily and are not particularly affected by moisture.

"When roads are built on the bad type of soil special care must be used in their design and construction and one of the remedies which seems to give the very best promise is the use of a layer of fine granular material as a 'blanket' course between the bad subgrade and the road surfacing normally used. Stone screenings containing the dust of fracture comply with this description of fine, granular material. The use of a layer of granulated material under concrete roads has worked out to very good advantage in several instances, some of which are mentioned in the September, 1925, issue of Public Roads, in an article entitled, "The Present Status of Subgrade Studies," reported by A. C. Rose. The usefulness of a blanket layer under concrete roads is perhaps not as apparent as under the macadam type. The so-called "frost-boil" in macadam roads laid on poor subgrade material is a familiar phenomenon in our northern climates and occurs during periods of thawing after severe freezing. At this time the subgrade is saturated with water and consequently is very soft. Wheel loads which of necessity are transmitted to the subgrade create pressure intensities high enough to cause plastic flow of the soft subgrade and the pavement is depressed under the wheel and elevated between the wheels by the upward pressure of the underlying wet plastic clay. Eventually the clay breaks through the surfacing material and more and more mud is forced to the surface with each passing vehicle. The phenomenon of 'mud-pumping' occurs upward through macadam just as it occurs up through ballast in a railroad track.

"A blanket or 'shut-off layer' of fine granular material is undoubtedly of considerable value under macadam laid in cold climates on a comparatively poor subgrade. In the first place, by virtue of the increased depth of the pavement, the pressure on the subgrade is decreased in intensity and, moreover, the pavement crust is strengthened, first because of its in-

creased thickness, but most important of all because the fine granular layer prevents the intrusion of mud up into the voids in the pavement. Thus, the full effective thickness of the pavement is maintained. This idea of the use of a layer of granular materials of the nature of fine stone screenings is very much worth while developing, and much research work can be started throughout the country that will, without question, lead to better macadam construction than we have had in the past. It is the purpose of your Bureau of Engineering to very thoroughly investigate the possibility of this construction, for it means much to all road-constructing agencies and to all road users, while to the producers of stone its significance is quite apparent.

"There is considerable discussion among highway engineers as to the development of the "secondary" type of road. Although large mileages still remain to be constructed the primary routes are being rapidly completed, leaving large mileages of lower type roads for secondary routes to be built in the immediate future. Stone can be used to very good advantage in this secondary construction. For instance, stone screenings might well be employed as a surfacing material on graded and drained earth roads, maintained by dragging and by the application of more screenings as required. In this way a very stable surfacing may be built up which will be in excellent condition to receive a higher type of construction when demanded by traffic. Instances of this procedure are available and similar experiments could be carried out to very good advantage in a large number of states. Such experiments should be encouraged by your Bureau of Engineering.

(b) Stone Dust.

"Stone dust is a waste product that holds strong marketing possibilities. Already some of you have installed vacuum recovering equipment which not only makes your plants more livable and your product free from objectionable dust, but in addition separates and makes available a large amount of finely divided stone dust which should have usefulness in a number of industries. Thus, as a filler in bituminous cements for asphalt pavements and in bituminous expansion-joint material, as a paint filler, as a fine abrasive and for the dusting of mines for the prevention of explosions, stone dust has usefulness and without question many other uses remain to be discovered. Research by the Bureau along this line should be well worth a strong effort.

3. Improvement in Crushed Stone

"At first thought one might conclude that there is little to be done to improve a material such as stone which is nature's product and which surely is unalterable in its physical properties. Such, however, is far from the case, for the minute stone is crushed its size and cleanliness become as important as its physical characteristics, and along these lines investigations are needed. An industry should not be content merely to supply the sizes its customers desire but it should be able to advise with them as to what sizes are best for a given purpose.

"What sizes are really best for concrete construction of all kinds, for macadam and for bituminous roads?

"What effect has the character of stone, whether hard or soft, on the sizes which should be used?

"What is the best and most practicable way to supply the consumer with stone really graded in the way he wants it?

"How can segregation of sizes be overcome?

"When should washing of stone be resorted to?

"These are sample questions which can be answered only in part at present but which will need some real investigation to answer in a satisfactory and convincing way.

"It is proposed that the Bureau of Engineering will conduct researches on these questions or have them conducted in the manner most likely to produce results. The producers themselves can be of great assistance by engaging in cooperative tests along some of the above lines at the several points, and an outline of these tests will be suggested at a future date. The users of stone can likewise help on researches in the field to their very great advantage, for these investigations are aimed primarily at helping to get better results in the final use of the material. If the user is benefited to the extent of securing stone constantly in conformity with his desires, it is obvious the stone producer likewise will reap a considerable measure of that benefit.

"Much attention has already been devoted by your Bureau to the problem of coarse aggregates in concrete roads and a study has been made of

the influence the size of aggregate has on the cost of the concrete. As a result of this study researches are now being strongly urged in several state highway departments to determine the best grading of stone for the production of the strongest, the most workable and most economical concrete. The results of this research should make for more economical stone concrete and therefore for more equitable competition with other aggregates.

"At this point I want to say very frankly and very earnestly that you producers have not always cooperated with the user of your product in supplying him with just the size and just the grading demanded by the specifications, and my general impression received from a number of sources is that you have suffered as a result. Stone for a given purpose cannot be skimped in certain sizes just because there happens to be a big demand for these sizes for other types of construction. You might gain temporarily thereby but in the long run you and the industry most emphatically will suffer. Happily this point is now better recognized but it needs your utmost and constant attention.

4. The Discovery of Means for Improving Constructions
(Utilizing Stone)

"Improvements in the qualities of those types of construction in which crushed stone is used would be of benefit to the user and by reflection to the producer. Much research has been performed in the past few years on concrete roads looking particularly to improvements in their design to suit present day heavy-load conditions. The possibilities of further research along that line are now more limited by virtue of the valuable facts which have already been brought to light. Nevertheless, much remains to be discovered as to the influence of various factors, including the aggregate, on the durability and life of the concrete road. The field of research in the development of other types of roads involving the use of stone remains practically untouched and in view of the probable development of cheaper road types for the great mileage of secondary routes, no doubt this field will be actively occupied in the future.

"The macadam road has not been developed in design to any extent nor have the principles of construction been changed. It is illogical to require thick edges for concrete roads and be satisfied with the unaltered old design for the macadam types. Much useful research is needed to show the most advantageous cross-section design for the "flexible" road, just as it was necessary for the concrete type. If research will improve the flexible types and show their limitations, they will be rendered better fitted for carrying heavy traffic and moreover will then be brought into more active competition with types which now alone are considered suitable. Your Bureau hopes to be able to suggest schemes of improvement logical enough to warrant their trial and investigation by highway constructing agencies. The use of a "blanket course" is right now a fit subject for thorough investigation, for it has already given good results and promises well. The use of a layer of crusher-run stone containing dust should likewise be generally helpful as a foundation layer. Means for increasing the lateral strength of macadam at the edges of the road should also be given a thorough trial and researches along these lines will be inaugurated if possible. Any improvement in design of any road type making for more efficient service behavior or decreased maintenance expense inevitably must lead to the increased use of that type.

"A study of the effect of size and grading of stone in macadam roads looking to their increased load-carrying ability or to the maintenance of their original riding qualities is another research worth undertaking.

"Still another field which is practically untouched is the maintenance of old concrete roads which have served their usefulness. What is the most economical procedure, a second story of concrete, a layer if bituminous concrete or bituminous macadam? A comprehensive series of tests of this kind, well laid out and in considerable detail, should be welcomed by those states and counties now confronted with concrete maintenance problems. An investigation should be conducted on the proper size of cover material for use with bituminous surface treatments on macadam on other roads. What size stone is best for given grades of bitumens? What is the best size for use in the bituminous treatment of the earth type road of the south? Stimulation of research along these lines and the publication of papers bearing on the results surely can help promote the proper and more successful use of

stone. But enough has been said to indicate how your Bureau might stimulate research which will lead to better design and construction of all types of roads in which stone is used.

5. Supplying Facts Showing Advantages of Stone in Roads

"It has already been nnounced that your Bureau of Engineering does not propose to enter upon any campaign of attack on competing aggregates. That will not be one of its functions and any such campaign within the crushed stone industry should be discouraged by the National Crushed Stone Association. For yours is a high grade and important industry which you have dignified and which you hope to further develop by identifying it with scientific research. Your development efforts will be strengthened by a strict adherence to business principles demanded by high grade industry. Furthermore, I know from experience how distasteful attacks on competing materials are to those whom they are expected to impress. I need not tell you how much better salesmanship it is to advance the merits of your own material than to decry your competitors' material. I do not mean to imply that you should not be fully informed as to the advantages and disadvantages of all competing aggregates, for most emphatically you should be so informed in order to better present the merits of crushed stone.

"There is much to be studied as to the relative characteristics of different aggregates. Some researches have already been completed and the results will be collected. Other researches will soon be published and still others are now under way. The facts from these researches will be made available to you. But there is still a great untouched field of research which might be undertaken on the relative characteristics of the various aggregates. As you well know most comparisons of concrete to determine the relative superiority of different aggregates have been made on the basis of the crushing strength of concrete, but has it ever occurred to you that the failure of a concrete structure through crushing is an exceedingly rare occurrence? Concrete roads having proper provision for expansion do not fail because of high compressive stresses and, moreover, the forces which do act on them act not once but thousands of times. Concrete roads are subjected to alternations of compression and tension with every passage of a motor vehicle; they are expanded and contracted by temperature every day and by changes in moisture content and in addition are subject to freezing and thawing. Cross-bending stress as well as direct tension are produced perhaps thousands of times daily and invariably the cracks that form in the surface are due to tensile stresses rather than to compression. We should accept compression tests merely as a tentative measure of the quality of concrete for road construction and in the meantime try to discover what are the effects of these oft-repeated stresses on concrete roads of different aggregates and having different characteristics. Thus, I have in mind the necessity for making tests, such as are not commonly made, on concrete containing different aggregates, including repeated static loads, repeated impacts, alternate freezing and thawing, alternate temperature changes, expansion and contraction, accelerated soundness tests, cross-bending and direct tension. Moreover, coupled with all this a complete survey should be made of the service behavior of concrete roads having different aggregates. You can now see that the possibilities of research for demonstrating the differences which exist in aggregates are very wide. The main difficulty is in getting the researches performed and many times of late I have wished for a well-equipped laboratory. However, these tests are being outlined in detail and their performance will be urged by those having proper facilities and sufficient interest to do the work. The government, state and university laboratories no doubt will undertake some of these problems in time and results will become available from different sources. The facilities offered by the Highway Research Board of the National Research Council for making field surveys must be kept in mind and perhaps you will be in a position financially to take advantage of these facilities at a later date. A survey conducted by this agency would be given general recognition throughout the country.

"As the research facts become available it will be the duty of your Bureau of Engineering to present these facts in such a manner that they will be easily understood. Likewise they should form the basis for technical papers. Such papers will be published

in the Crushed Stone Journal, and in separate form by the Association. Papers will also be presented before technical bodies from time to time and will be published in the technical press. Facts which have become established eventually are incorporated in specifications and it will be my duty to present such facts before the important specification-writing bodies.

6. Other Service to Crushed Stone Producers

"Perhaps enough has been said to give you some idea of the research work which remains to be performed to help the industry. You also probably have a better idea of how the Bureau of Engineering can stimulate the needed research and finally how it is proposed to make the established facts useful to the industry. There are other ways in which you can be assisted. The publiction of standards of various sorts covering specifications, design, and construction of roads involving stone will serve to keep stone actively before the user. Proper standards which can be embodied in local specifications surely will serve to engender a more favorable attitude toward your product and your salesman should be helped correspondingly."

"The limited publication and analysis of helpful statistics should also be undertaken. As you can well realize there is a tremendous amount of detail work to be accomplished. Much of it deals with the obtaining of facts through research. Research requires painstaking work and some of you will get impatient for results. You would like to have them immediately. It is possible time will disclose the necessity for speeding up some of the detail work through the employment of assistants and it seems not at all improbable that time will also demonstrate the desirability of the industry's performing research work in a laboratory of its own or in field laboratories established for that purpose. The main consideration right now is that your Bureau proceed along lines that are sound and direct. You are building for the future and the foundation is most important; for the super-structure must be well supported in years to come. A number of you have valuable ideas that will contribute to the usefulness of your Bureau of Engineering and your Director most certainly will welcome them."

Following Mr. Goldbeck's report on the proposed research work of the association several leaders of the association expressed themselves in accord with the policy. The selection of Mr. Goldbeck as director of the association's bureau of engineering not only met with the approval of the membership but he was assured of a unified cooperation and support. It was indeed interesting to also hear of the many engineers, highway departments, research bureaus, etc., that commended the selection of Mr. Goldbeck.

The conclusion from a survey of concrete pavements recently conducted by the Highway Researh Board for the National Research Council were presented by C. A. Hogentogler, chairman of the reinforcement investigation for the Highway Research Board. These conclusions can be summarized as follows:

1. The amount of cracking and subsequent disintegration is a function of time; thus, the rate of cracking is a measure of the life of the pavement.

2. The data show that steel reinforcement reduced the rate of cracking and thus increased the life of the pavement. This applies both to concrete pavements and other pavements laid upon a concrete base.

3. Crack reduction is more economically accomplished by the use of steel reinforcement than by additional thickness of concrete.

4. A greater reduction was afforded by small steel members closely spaced than by larger members widely spaced.

5. Increasing weight of mesh from 25 to 56 pounds per 100 square feet considerably reduced the cracking.

6. Mesh reinforcement, 25 to 56 pounds per 100 square feet, reduced cracks 35 to 70 per cent in pavements of like thickness.

7. Mesh reinforcement, 25 to 56 pounds per 100 square feet, and bar mat reinforcement 64 pounds per 100 square feet—25 per cent longitudinal—reduced cracks more than one additional inch of concrete; but one additional inch of conrete reduced cracks more than bars (42 to 48 pounds per 100 square feet) placed transversely only.

8. With good crushed stone aggregate, 56 pounds per 100 square feet mesh reinforcement, or 170 pounds per 100 square feet bar reinforcement, 50 per cent each way, caused a reduction in combined transverse and longitudinal cracks equal to that in-

dicated for two inches additional center thickness.

9. Mesh reinforcement of 38 pounds per 100 square feet has been effective for a thin layer of concrete laid as resurfacing upon an old concrete road.

10. One additional inch of edge thickness reduced corner cracks more than mesh reinforcement 25 to 56 pounds per 100 square feet, or three-eighths to three-quarters inch bar reinforcement; but progressive destruction following the appearance of corner cracks was arrested by steel reinforcement.

11. All types of steel reinforcement across cracks tended to hold together fractured slabs.

12. Bar reinforcement across transverse joint, without proper provision for slippage and clearance, resulted in breakage and subsequent expensive repairs.

13. For long slabs, seventy-five to one hundred feet, or over, edge bar reinforcement with continuous bond caused corner cracks if the area of steel exceed one-quarter square inch.

14. A remarkable agreement was found to exist between results of observations on roads in service and results furnished by a wide range of experimental roads and laboratory tests.

During the discussion of Mr. Hogentogler's report it developed that the amount of crack reduction of mesh reinforcement with crushed stone aggregate was about 45 while the amount of crack reduction with gravel was about 22.

Statistics which were rather amusing but interesting were given by Major T. M. Ripley, division engineer, department of public works for Albany, New York, in a paper following Mr. Hogentogler. To illustrate we quote:

"There are in the United States two million eight hundred and sixty-six thousand miles of public roads which are being improved with pavements of more or less permanent construction to the extent of about thirty-five thousand miles per year. If this rate of construction is maintained for the next ten years, there will yet remain unpaved over two million miles. It is conservative to estimate that the paving of a mile of highway requires fifteen hundred tons of broken stone, if the pavement is either concrete or two course bituminous macadam. Such a program would require over fifty million tons of stone per annum. In 1925 New York made 547.37 miles of pavement which required over a million tons of stone. This does not include the paving done by the counties, towns, cities and villages which would increase the amount above given, by not less than 100 per cent. There were in 1920, 11,212,654 rural dwellings in the United States—20 692 204 in all.

"This year there will be 20,000,000 motor vehicles licensed. It is conservative to say that one half of this number will be in the rural community class. We are all familiar with what the motor vehicle has done in the past. Can we not predicate some of its influences in the near future? To come off a paved street or road onto a soft muddy drive with an automobile is neither pleasant nor economical.

"With the foregoing premises, let us make a deduction for an educational selling campaign, viz., one half the total number of rural dwelling are occupied by automobile owners, who have not an improved entrance to their garage or barn; the average distance from highway to garage, including turning area near garage, equals one hundred feet and the width to be improved, equals nine feet.

"Now with your pencil, you can easily arrive at the tonnage necessary to put these drives in passable condition—If we assume a depth as shallow as three inches, it would mean ten tons per drive or 56 606,327 tons.

"Can you not go out and get this business? If you can clean up one or two back yards in a neighborhood, thereby giving mother a chance to feed the chickens without putting on her rubber boots, the women will see that the balance is cleaned up. I know the rural community likes crushed stone, because I have many evidences of its use in small quantities along the private drives adjacent to our improved roads. Many of these users we had to curb, in their zeal for better driveways, in order to have material for doing our state work.

"Where one ton is stolen from us, I want you to sell five and thereby, both will we benefit and your customer can keep or regain his self-respect.

"There is no reason why the use of broken stone can not become as popular and as necessary for a properly equipped home as an automobile or a carpet sweeper. Its proper use would keep a lot of dirt out of the house, off the machine and prolong the life of all the furnishings.

"Let us now take up the question of variation of ingredients caused by the variation in proportion of different concrete mixtures:

1-1½-3 requires 7.6 sacks cement, 0.42 cubic yards sand, 0.84 cubic yards stone.

1-2-2 requires 7.0 sacks cement, 0.52 cubic yards sand, 0.78 cubic yards stone.

1-2-4 requires 6.0 sacks cement, 0.44 cubic yards sand, 0.89 cubic yards stone.

each per cubic yard of concrete.

"By analyzing the above figures, you will find that the second mixture requires 7 per cent less stone than the first and that the third requires 6 per cent more stone than the first, and 14 per cent more than the second.

The manufacturers exhibit was formally opened on Monday evening to the music of a Highland Laddie Bagpipe Band. The interest at this exposition was quite marked and judging from the comments of those who visited the exposition we are inclined to believe that the National Crushed Stone Association recognizes the educational value of this part of their convention. For the first time the National Crushed Stone Association maintained a booth which seemed to be the center of interest. The following were represented by booths at this exposition:

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Armstrong Mfg. Co., Waterloo, Ia.

Austin Mfg. Co., Chicago, Ill.

Blaw-Knox Co., Pittsburgh, Pa.

Bucyrus Co., South Milwaukee, Wis.

C. G. Buchanan Co., Inc., New York City.

Canadian Explosives Limited, Montreal, Que.

Cement, Mill & Quarry, Chicago, Ill.

Columbus McKinnon Chain Co., Columbus, Ohio.

Easton Car and Construction Co., Easton, Penn.

E. I. duPont de Nemours & Co., Wilmington, Del.

The Fate-Root-Heath Co., Plymouth, Ohio.

Flexible Steel Lacing Co., Chicago, Ill.

Gill Rock Drill Co., Lebanon, Pa.

General Electric Co., Schenectady, N. Y.

Geo. D. Whitcomb Co., Rochelle. Ill.

Hadfield-Penfield Steel Co., Bucyrus, O.

Harnischfeger Sales Corporation, Milwaukee, Wis.

The Hayward Co., New York City.

Hendrick Mfg. Co., Carbondale, Pa.

Hercules Powder Co., Wilmington, Del.

Keystone Consolidated Publishing Co., Pittsburgh, Pa.

Koehring Company, Milwaukee, Wis.

Koppel Industrial Car and Equipment Co., Koppel, Pa.

The Loomis Machine Co., Tiffin, O.

The Lubriko Co., Philadelphia, Pa.

Marion Steam Shovel Co., Marion, Ohio.

Mussens Limited. Montreal, Que.

National Crushed Stone Association.

Northern Explosives Limited, Montreal, Que.

The Osgood Co., Marion, Ohio.

Pit and Quarry, Chicago, Ill.

Robins Conveying Belt Co., New York City.

Rock Products, Chicago, Ill.

The Sanderson-Cyclone Drill Co., Orrville, Ohio.

S, G. Taylor Chain Co., Chicago, Ill.

Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

The Thew Shovel Co., Lorain, Ohio.

Traylor Engineering & Mfg. Co., Allentown, Pa.

The W. S. Tyler Co., Cleveland, Ohio.

Vulcan Iron Works, New York City.

Williams Patent Crusher and Pulverizer Co., St. Louis, Mo.

A smoker and entertainment was attended by practically everyone in attendance at the convention on Monday evening following the manufacturers' exposition. The spirits of the occasion flowed freely and the hilarious condition of those present was sufficient proof that everyone was satisfied.

Tuesday morning the sessions were resumed with an excellent attendance and the proceedings started promptly. Major Acheson of the New York State Department of Public Works was first introduced to the convention. Mr. Acheson gave a very interesting review of the highway situation of the United States. In the construction of highways as a whole there is room for all types and Major Acheson stated that this situation also allowed for all classes and all grades of good material.

The development of the asphalt industry with special reference to the use of crushed stone was discussed by Prevost Hubbard, chemical engineer for the asphalt association. This address is reprinted in full elsewhere

in this issue and should be studied by every crushed stone producer.

G. A. Hutchinson of the Kentucky Rock Asphalt Company read a paper on Kentucky Rock Asphalt. The consumption of crushed stone in the use of Kyroc which is the product marketed by the Kentucky Rock Asphalt Company.

The transportation business from the railroad point of view was presented in an address by E. F. Neagle, general freight agent for the Lehigh Valley Railroad. It is of interest to our readers to know that the Advisory Boards are recognized by the railroads and their cooperation sought and appreciated. These boards have demonstrated the service that they can render the various producers and representation by producers should be sought on those committees dealing with their interests. They can be of service in reducing the possibilities of car shortage, in handling complaints concerning poor cars, etc.

The quarry section of the National Safety Council was explained by E. E. Evans, president of the Ohio Crushed Stone Association. Mr. Evans is also chairman of this quarry section. Your editor is personally acquainted with the great work being done by Mr. Evans and also Mr. D. C. Souder, who is secretary of the Quarry Section in organizing the quarry operators into a unit for the purpose of studying accidents and their preventions. The attendance at the first quarry section of the National Safety Council in Cleveland last fall was not well attended and all who heard Mr. Evans should give careful thought to assisting in the work. Affiliation with this work will result in a financial return far in excess of the time and money involved.

A very practical paper on the Fire Hazards of Stone Crushing Plants was presented by Mr. D. C. Souder. This paper is reprinted in full in this number and is worthy of a careful reading. The discussion following this paper by some of those who have lost plants by fire revealed the need for a better understanding of fire prevention and insurance risks.

Tuesday afternoon was devoted to problems of interest to superintendents and operating men. A. G. Seitz of the Rock Cut Stone Company acted as Chairman. The program proved to be of some interest to everyone and the attendance was nearly as large as the general sessions.

The program was opened by A. B. Mack, assistant manager of the Kelley Island Lime and Transport Company with a paper on the "Human Element in Plant Operation." Any sound policy in dealing with the human element in industry must recognize three factors, namely, confidence, justice and truth, asserted Mr. Mack. Another position held by Mr. Mack is that the employer must assume the burden of bringing about wholesome relations between the employer and employee as the employer occupies the unique position of being both judge and jury. Good workmanship should be developed and encouraged because as the speaker said "the workman today has just as much pride in his work as in the past." In the Kelley Island organization the workmen are represented by committees whose personnel is of their own selection. It was interesting to hear Mr. Mack state that seniority is recognized by his organization to the extent that each employee could look forward to the next higher job and when open he could have it if he considered himself fit for it. However, it is necessary for him to demonstrate his ability to hold this job and if he does not produce the necessary results, either he himself or the workmen's committee will soon be apprised of the fact and he retires to his former job without any hard feelings or dissatisfaction.

The advantages of a tidy plant were humorously and entertainingly discussed by Mr. A. L. Scott, superintendent of the Leroy plant of the General Crushed Stone Company. Mr. Scott has a recognized reputation for operating a neat plant and he accounts for his success by the fact that his workmen are interested in neatness and good order and are willing to reflect the desires of the management in this direction. An attractive plant increases the interest of the workmen, decreases labor turnover, increases tonnage and inspires care upon the part of the workmen and thus helps to reduce accidents, claims the speaker. When you know that 65 per cent of Mr. Scott's men have been with the company for ten years or more, doesn't it seem reasonable that some of these factors have been an advantage?

"Oxygen, the Wonder Worker" was the subject of an address by F. E. Rogers of the Air Reduction Sales Company. Mr. Rogers' remarks were concerned with oxyacetylene welding processes. The development of this industry from its early days was

traced to the present day use of the process, and discussed. The oxygen demonstration which followed was of interest as were also the pictures showing various applications of the welding torch.

A paper entitled "When and How to Wash Stone" presented by C. E. Glassen of the Columbia Quarry Company, was read to the convention in Mr. Glassen's absence. The following digest of this paper is of particular interest:

When and How to Wash Stone

"The ever-growing use and popularity of concrete is not the result of experiments by users, who in many cases, take a chance and find new uses for concrete, by accident; but, instead, the engineers who design structures resort to the laboratories, where exact specifications for mixtures, sizes of aggregates and quality of cement are scientifically determined. The engineers are now able to design a mixture for concrete, which will come up exactly to any requirement.

"The average well regulated crushing plant will make stone of proper mixture and well screened; but in no case that we know, is stone produced without a considerable amount of dust coating, and it seems quite impossible to remove this coating by screening. Whether or not, this dust coating interferes with the binding of cement and stone, is somewhat in question, but in our opinion, the strength of concrete can only be determined by the strength of the binder, and the contact between the binder and coarse aggregate. If this be true, is it not reasonable to assume that with stone covered with dust, especially if the stone be of a kind that breaks in a way to expose innumerable craterlike surfaces, each little pit filled with dust, a close contact between the stone and binder cannot be had?

"We know that the closely grained dust is in a sense waterproof, and for that reason will prevent the moisture in the binder from penetrating the surface of stone, a condition very essential to a thorough bond, and possible only with clean stone, and other more porous coarse aggregates. With this dust rinsed off and the surface of stone rendered clean, the moisture containing cement will be absorbed by the stone itself, and the bond made deep under as well as on the rough surface making bond, a condition not possible with aggregates comparatively impervious to moisture even though such aggregates be thoroughly washed.

"Without rinsing the stone as described, the dust might become removed in part, and in the process of mixing concrete, that portion removed will then become a part of the cement binder, and will have reduced the strength of same in proportion to the dust thus removed. To compensate for this, more cement should be added for concrete of equal strength at additional expense.

"We are so firmly convinced that washed stone will be demanded by critical engineers and others in the near future, and that washed stone of good quality will automatically displace other rough aggregate if permanence and strength are required, that plans are already made for an installation of unit rinsers, each size stone for itself, in our new crushing plant.

"The dust resulting from the process of rinsing can be easily carried to settling ponds and reclaimed if desired, after it dries naturally, or at once, by a drying system and bagged. Being fine in structure and of good quality, such a product finds a ready market and a good price.

"The rinsing process should be carried on after the stone has been reduced. This would require the least water and apparatus. The advantages of washing stone are numerous and, we believe, the gradual more exacting requirements of engineers and competition of washed aggregates will require operators of crushing plants to wash stone somewhere in the process of production.

"To our knowledge, many thousand tons of screenings, ranging in size from 1 inch down, are in storage piles throughout the country, and are considerable loss, the loss being absorbed by the stone sold. By properly washing as a regular adjunct to the crushing operation, stone formerly wasted could be sold at a good price, thereby reducing the unit cost per ton of stone produced, and saving the entire cost of storing, which in some cases represents a large amount of money for labor, to say nothing of the yard-room required for the purpose. Washed stone of proper characteristics will make all other rough aggregates secondary to it. For chemical use nothing will remove objectionable matter from stone as well as washing.

Rock excavation on the Hydro Electric Canal was described and illus-

trated with slides by Mr. A. V. Trimble of the Hydro Electric Commission. The last unit of this enormous project was placed in operation on December 25th, 1925, and a peak load of 552,000 horsepower reached in December. The work involved many varieties of machines and necessitated the erection of an excavating plant and a rock crushing plant.

The total earth excavated in forming the canal proper amounted to about 11,000,000 cubic yards. The total rock excavated from the forebay and canal exceeded 4,700,000 cubic yards.

The excavation for the Intake Works was handled by dredges, both dipper and suction type, as was the deepening of the Welland River, assisted by a traveling cableway equipped with a four yard bucket.

The earth section of the canal was excavated partly by section dredges, partly by traveling derricks equipped as draglines and partly by shovels.

The overburden of the forebay was removed by scrapers and a small shovel; the overburden of the canal and the rock in both the forebay and canal by shovels and dump cars.

The crushing plant was located near the forebay, and was fed with rock from the forebay and adjacent canal excavation. The rock was dumped from the 20 yard dump cars into a hopper situated over a large 60x84 inch jaw crusher. The crusher was set below track level and was driven by a 250 horsepower motor. The discharge from the crusher was carried by a belt conveyor to a secondary crusher house where three gyratory crushers reduced it to 2½ size. From the crushers the material was carried by belt conveyor to a screen 84 inches x 30 feet which removed the oversize and dust. The rock was then carried by a suspended belt conveyor over a storage pile.

The main reclaiming conveyor discharged to bins above railroad tracks and to another 24 inch conveyor feeding the mixing plant at the powerhouse. Sand was brought in cars and discharged through a bin to a bucket elevator which fed a second suspended conveyor in line with the stone conveyor. The stone reclaiming conveyor was carried under the pile, and was used to reclaim. About 1,118,000 cubic yards of rock were crushed in all and about 300,000 yards of sand handled by this plant.

The sessions on Wednesday morning centered largely around the problems of railway ballast. An excellent paper on this subject was presented by F. J. Stimson, assistant chief engineer, maintenance of way for the Pennsylvania railroad and chairman of the ballast committee of the American Railway Engineering Association. Mr. Stimson referred to the increase in loads and speed of traffic carried by the rails. This paper will be reprinted in full in a later number. Several distinguished Canadian and American engineers contributed to the discussion. Mr. John Rice also presented the report of the ballast committee at this session. This discussion and the report of the ballast committee will be published later.

The use of crushed stone in highway construction in New Hampshire was discussed in a paper by Frederick E. Everett, commissioner and state engineer for New Hampshire. While this address was concerned largely with the road problems it was of interest to those present. The slides which followed gave a good idea of the tendency in road construction. Mr. Everett is to be complimented upon the frankness with which he discussed conditions in his state.

A somewhat antagonistic address was given by S. L. Squire, deputy minister of public highways for the Province of Ontario. Mr. Squire seemed to think it necessary to justify the use of wayside municipal operated aggregate plants. He stated that a change of ownership does not change the quality of the product. However, nothing was said about a change in personnel or a change in policy which so often is noticed in state operation of activities in competition with commerical interest. The Province of Ontario last year produced 600,000 tons of material themselves while they purchased only 400,000 tons of the commercial product.

The report on the committee of standards and the report of the subcommittee for the standing committee on drilling equipment was adopted. The greater part of the drilling equipment has been standardized and agreed to by all manufacturers of drilling equipment represented on the committee.

The afternoon sessions on Wednesday were devoted to salesmen, and Mr. H. H. Brandon of the Ohio Marble Company acted as Chairman. Marketing and sales problems were discussed in an informal manner.

F. C. Murphy, secretary of the Brownell Improvement Company, gave

some practical suggestions on selling and holding a customer. Mr. Russell Rarey of Marble Cliff Quarries Company discussed the secondary road problem. The market possibilities under the Green Bill of Ohio which provides for the construction of "feeders" or secondary roads was estimated to be 25,000 miles of road.

I. W. Wortman of the Morris County Crushed Stone Company discussed the service that salesmen should develop in their sales work. He also touched upon the cooperation necessary between the sales and the production organizations. A. T. Goldbeck suggested some ways and means for cooperation between his department and the sales organization of the different companies. This sales program, which was the first to be held as a part of the National Crushed Stone Convention program, presented an excellent opportunity for developing a uniform sales policy. Next year a place for such a session should be found on the program and some intensive thought given to satisfy the need. As Mr. Goldbeck said, "A good salesman should know everything there is to be known about his product, and he must be in a position to advise with those who are concerned with its use." Why not make that the purpose of future sales meetings?

The annual banquet was held on Wednesday evening with C. M. Doolittle of the Canadian Crushed Stone Corporation Limited as toastmaster. Sir Henry Thronton, president and chairman of the board of directors of the Canadian National Railways, presented a pleasing address in which he stated that crushed stone is the ideal ballast. The other speakers of the evening included John A. Macdonald, state highway commissioner for Connecticut; Charles M. Upham, state highway engineer for North Carolina and director of the Highway Research Board of the National Safety Council; and C. D. Garretson of the Rotary International.

The feature of the last session on Thursday morning was the address of Dr. Firman E. Baer, Director of the Soils Department of Ohio State University. This paper is reprinted in full in another section of this number, and it is recommended to our readers as one of the most interesting papers of the convention.

The subject of freight rates also came in for considerable discussion at this session. W. L. Sporborg reported on the decision of the I. C. C. in the case of Docket 15329 which was a case relative to rates on sand and gravel from points in Western Pennsylvania to points in Ohio, West Virginia and western New York. The I. C. C. sustained the sand and gravel producers in their contention that the existing rates were too high and acted by prescribing a mileage scale. This scale, which was for one line movement, was as follows:

20 miles and under, 70 cents a ton;
21 to 40 miles, 70 cents a ton;
41 to 60 miles, 80 cents a ton;
61 to 80 miles, 90 cents a ton;
81 to 100 miles, $1.00 a ton;
101 to 125 miles, $1.10 a ton;
126 to 150 miles, $1.20 a ton;
151 to 175 miles, $1.30 a ton;
176 to 200 miles, $1.40 a ton.

The other freight rate matter concerned exparte 87 and the situation involved was explained by W. R. Sanborn of the Lehigh Stone Company. Mr. Sanborn dwelt at length on the need for real cooperation among the producers in preventing a united effort such as was needed before the commission at its hearing in Kansas City. The lack of this cooperation evidently had much to do with the weak case presented by the crushed stone producers.

The various committees made their reports, and the report of the nominating committee was unanimously adopted. Otho M. Graves was reelected and the following regional vice-presidents were elected: A. R. Wilson, G. J. Whelan, Sterling Tompkins, Thomas McCroskey, W. R. Sanborn, and C. H. Doolittle.

The manufacturers' division at their annual meeting elected M. B. Garber chairman and S. R. Russell and N. S. Greensfelder to serve with Mr. Garber on the board of directors of the National Crushed Stone Association.

The new officers were installed, and Mr. Graves then closed the Ninth Annual Convention of the National Crushed Stone Association.

In reflecting upon this convention we are impressed with the credit due C. M. Doolittle of the Canada Crushed Stone Corporation Limited for his part in making this such a remarkable convention. We also wish to call attention to the progress of the past year made by the officers under the able direction of Otho M. Graves. The sacrifice of personal time and energy which will be made by Mr. Graves and the officers in carrying out the ambitious program which was launched at this convention merits our grateful appreciation.

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The Haiss Creeper Loader will load sand right from the bank—if you have a market for bank run sand and gravel.

Or it will dig and load 2 yards a minute from a pile of crushed stone. Run your crusher to capacity and store the surplus production on the ground. A Haiss Loader makes it possible—and profitable.

How many trucks do you want to load—what size trucks and what materials? Tell us and let us recommend a way to put loading on a true economy basis.

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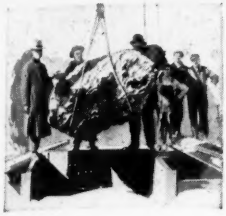

How the "Mammoth" Crushes 48" Limestone to 1½"

In even less time than it takes to tell (40 seconds to be exact) 48" cubes of limestone are reduced to 1½" in one operation. Every quarry operator will immediately recognize the economy of this method compared with that employing a primary and two or three secondary crushers with their accompanying elevators, conveyors, drives and buildings. In fact wherever the "MAMMOTH" has been seriously investigated, sales by the Williams Company have resulted. John Herzog & Son's installation crushing 36" stone is a typical example of the saving possible. He saved $20,000.00 in first cost, $4,200.00 annually and cut crushing costs 53%.

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1. *Quarry run rock as large as 48" cubes, anything the shovel can pick up, can be loaded on the feeder and carried to the crusher in a steady uniform flow.*

2. *As fast as the rock is brought up by the feeder it is handled by the crusher without any hesitancy. 40 seconds is the average time required to crush a 48" cube.*

3. *As the stone enters the hopper it is struck again and again by the heavy hammers. Each hammer strikes a 33-ton blow and in the No. 9 18,000 of these 33-ton blows per minute quickly reduce the material to the desired size.*

4. *Crushed material quickly escapes through the openings in the grates and is carried away by the conveyor. No oversize material is found in the finished product as the grates hold the rock within the crusher until properly sized.*

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Trinity Portland Cement Co., Fort Worth, Texas.
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Sand and Gravel Problems Discussed By Producers At Atlanta Convention

DETERMINED to carry forward every detail of an ambitious program laid out for the coming year, the National Sand and Gravel Association closed its three day convention at the Atlanta-Biltmore hotel, Atlanta, Georgia, Thursday, January 21. When John Prince, president of the association, declared the meeting adjourned, the members agreed that the session had been the best in the history of the organization. Here are its accomplishments in the eyes of the veterans of the business.

1. A definite move against the practice of guessing by the yard as opposed to selling by the ton.
2. Arrival at a working basis for gravel ballast specifications with the foundations for making 1926 "a gravel ballast year."
3. Election of new officers headed by Hugh Haddow, Jr., of the Menantico Sand and Gravel Company, Millville, New Jersey, as president.
4. A clear view of the possibilities of the concrete products' business and its economic entwinment with sand and gravel.
5. A $36,000 budget with large plans for the engineering and research division under the direction of Stanton Walker.
6. A move defeated to sell the associations bulletin to a private concern and adopted a sound economic policy for the publication.

But these do not tell the whole story of the convention. There was a marked feeling among the producers that the time was approaching when sand and gravel men would be forced to take some action in behalf of the buying public and themselves against sharp practices of unfair competitors and the marketing of inferior sand and gravel by these same unethical competitors. The operators also showed a desire to have a rational basis established for the figuring of depreciation in income tax returns and a committee was appointed to go into the question and report at the next convention.

The convention got under way promptly at noon Tuesday with the luncheon of the board of directors. The session was not executive and more than thirty producers sat down to thrash out the problems. President Prince announced that the association had increased in membership more than 30 per cent during the year and that the revenues had swelled 20 per cent. Stanton Walker to head the Engineering and Research division, the organization had obtained the ideal man for the position.

It was learned that several of the leaders in the industry believed that the recent rulings in Pennsylvania which were claimed by some to be an unjust discrimination by the state highway department in favor of crushed stone was really the fault of one or two gravel producers in the state and not due to politics.

Mr. Prince's statement at the directors' meeting was followed by a discussion of the business situation in Southern California. It was brought out in the discussion that the Pacific Coast Sand and Gravel Association has far outstripped the parent body in accomplishments. The Pacific coast body although now centering its activities in Southern California and particularly in Los Angeles, plans as time and finances permit to extend its thorough work northward to the Canadian border.

Here are some of the things it has already accomplished for the benefit of the public and the trade:

It has abolished selling by yardage in Los Angeles by city ordinance and by trade practice in the surrounding territory.

It has practically done away with all overtime, Sunday and holiday work.

It has established a 10 cent a ton discount for cash which has in turn resulted in prompt collections. As an example of the result of this practice it was stated that one firm has been able to meet more than 98 per cent of its bills before the tenth of the month. Practically all the sand and gravel in the territory is now sold on a strictly cash basis.

It has discouraged machinery firms from financing new plants.

The invader in the field is compelled to obtain a city permit before he can open a pit or quarry. Notices must be posted in the neighborhood giving objectors a chance to appear.

Hugh Haddow, Jr.

When the association entered the field, the business was demoralized by trade acceptances and slow payments, new concerns were constantly entering the field without sufficient capital and were as constantly failing with great economic loss and considerable damage to trade practices and standards. These things have been abolished and the association has played no small part in ending the abuses. The association employs a full time manager, E. Earl Glass, who has an even more ambitious program in prospect, including the rational determination of percentages of depreciation to be figured for income taxes. The association now embraces practically all the producers in the district who make quality an ideal and it is resolved to refuse membership to any who do not uphold the trades quality requirements. It expects to make substantial expenditures for promotional work next year.

All this which came out at the luncheon table discussion preceded the introduction of the treasurer's report by J. L. Shiely. A three thousand dollar deficit was reported in the account of the National Sand and Gravel Bulletin published by the association. A proposal to drop the publication and another proposal to sell it to a private concern were defeated by the unanimous instruction of the directors to the budget committee to put the publication on a sound financial basis by obtaining advertising.

As the meeting adjourned early and there were no scheduled sessions of the convention the groups which formed to discuss business conditions devoted a good deal of thought to the questions of the government building program and the continuation of federal aid to highway construction and similar problems.

The general opinion was that the curtailment of the government building program advocated by the administration had struck a snag and that a more liberal appropriation for federal structures could be expected. There seemed to be little fear over the possibility of stricture on the purse which aids state roads and much optimism over the prospects for extensive use of gravel for railroad ballast. It seemed to be the general impression that the south would be a fertile field if the cotton crop made the section prosperous and the crop would be good if the boll weevil could be whipped.

By Wednesday morning about 200 members and guests had registered. The ladies were taken on a sight seeing trip to Stone Mountain, Wednesday morning, while the actual sessions of the convention got under way. Governor Clifford Walker of Georgia, who had planned to welcome the visitors was forced to be away from Atlanta, and the meeting opened with Mr. Prince's address.

"During the past 15 years the growth of the industry has been marked and the influence of this Association has become important to every producer," said Mr. Prince. "Production has increased to twice and almost three times what it was 15 years ago and the value is over four times as much. This is because the quality of the product has increased, due to the greatly increased production of washed sand and gravel.

"It is estimated that the geological survey for 1925 will show a total production of sand and gravel of all kinds, prepared and unprepared, manufactured product and pit run of 170,000,000 tons. If all were used for 18 foot concrete road it would have ten roads from the Atlantic to the Pacific and ten roads from Canada to the Gulf. If all had been loaded in railroad cars, every freight car in the United States, every box car and gondola, bad order and in going con-

dition, would have been loaded and unloaded five times during the year. Of this tremendous tonnage about one-fourth is represented in this association.

"Increasingly of late, and during the past year in particular, there have become evident in the association the good effects of the sound policies that have controlled our organization for some years past. Largely does the present excellent position of our association reflect credit on the energetic policy of hard work and economy of our executive secretary, Tom Barrows.

"The growth of the association in tonnage, in membership, in accomplishment and in importance to the industry during the year past is not the result of any special drive during the year, but is rather the cumulative effect of much that has gone before.

"Following the policy laid down by the last convention, the executive committee has held six open meetings in different parts of the country. To these meetings have been invited the producers of each section. Thus your committee has been able to learn from the producers themselves the particular problem of each section and counsel with many of our members concerning our national problems and the accomplishments of our national association.

"The second matter of importance that has held the attention of your officers during the year has been the actual establishment of an Engineering and Research Division.

"In the good effect upon the industry and in usefulness to our members, this is, I believe, the most important advance made by the association since its organization. It is given second place here only because the problem of active membership and money with which to operate the association still has to occupy first place.

"The need of a national engineering service has long been recognized and would have been established before, had the support for it been forthcoming sooner. The future of the industry and the usefulness of the association will be more and more vitally effected by the accomplishments of this division.

"Mr. Barrows has secured as head of this department a man who by reason of his personality, his training and experience is peculiarly fitted for the work. After long consideration of the subject and with a full knowledge of what is involved, I must report to you that I know of no man, regardless

Stanton Walker

of professional standing, better fitted to make a success of this Division than Stanton Walker.

"To those of you who compete with crushed stone producers this will bring to mind a similar undertaking recently inaugurated by that association. I believe good business will dictate to us that it is wise to wish them every success in this effort.

"Considering the high type of engineer they have chosen in Mr. Goldbeck, and providing they give him full and enthusiastic support, it can mean only more intelligent competition between the two industries.

"Both associations are now actively undertaking to arrive at the facts. When facts are established and recognized between competitors, you have the first and most important basis for an understanding to the advantage of both.

"The larger particular problems of the association have been fully covered in the printed report of our Executive Secretary. A few comments only are necessary to cover them.

"In the Western Rate case, a meeting of some of the interested producers was called last September by the National Association. A policy was there agreed upon and a budget proposed. Within two weeks the entire amount necessary, some five thous-

and dollars, was in hand, and the preparation of the case underway. The National Association had created such a spirit of cooperation and confidence among the producers of the west that the whole case has been prepared and presented, paid for by the Western producers and administered by the National Association without having developed serious difference of opinion.

"The preparation and presentation of this case could hardly have been improved upon. It cannot fail to have great influence on the rate situation of mineral aggregate throughout the entire country.

"However, I could warn you that all this effort may have no bearing on the conclusion of the Interstate Commerce Commission. It is entirely possible, for example that the Commission may decide the Western Roads need increased rates to provide increased revenue and that it will not be good policy to make any exception to the increase.

"In such event the Commission may not even consider the evidence. Nevertheless the National Association has added an accomplishment to its record, for the confidence developed in the industry through the exercise of this ability to cooperate is worth the price.

"In Pennsylvania and New York there has been apparent discrimination by the Highway Departments against the use of gravel for concrete roads.

"While the producers affected have been organized and a willingness to cooperate developed under the most difficult circumstances, still much of the work of solving this longstanding problem lies ahead for our Engineering Division. The time required to accomplish this must not be underestimated.

"From what I know of the situation it may easily develop that much of the fault lies with one or two producers of gravel in that territory. A producer who is so ignorant or short sighted as to neglect the proper preparation of his material or who refuses to understand the importance to him of specifications prepared to produce the best concrete obtainable, has no right to a membership in this association.

"I believe the time has come when we should refuse membership to a producer who does not market a satisfactory material or who does not make an effort to correct conditions which tend to discredit our product or injure the standing of our members.

"A notice of membership in this association should be a guarantee of fair dealing and a dependable product best suited to the purpose intended. This has already been largely accomplished without conscious effort on our part by a process of natural selection.

"The producer who has the vision and the understanding of his own good to support this association is beyond doubt the one most likely to apply sound methods and the ideals of service to his own business.

"With the growth in importance of this association and the more obvious advantages of membership, others not so desirable will seek admittance for the temporary advantage they will gain. If we continue to be watchful for this danger and jealous of our good name, I believe the time has come when we will individually be greatly benefitted by the uniform use of the name of the National Sand and Gravel Association in all our individual advertising.

"The effectiveness of the long standing policy of this association to develop mutual understanding between producers is becoming evident. While the National Association neither directly nor indirectly concerns itself with price, yet it is self evident that the growth of the larger viewpoint among producers is bound to create business stability and prosperity in the industry.

"In an annual review recently published this condition is noted: 'The general price trend has been downward, a condition which is frequently accompanied by disastrous price wars. These serve no good purpose to either the producers or the consumers and have been notably absent in the industry this year. The review indicates that while not all the producers have received a return sufficient to meet the requirements of prudent business methods, yet such conditions have not affected any great tonnage. This is no doubt due to the increased feeling of responsibility in the industry and the appreciation of the broader viewpoint of our business very largely brought about by this association.'

"The reception given public offerings of bonds and stocks of our members shows the effect on the public mind of stability and sound business methods.

"This association is not merely a

theoretical organization contributing to the good of its members in a purely abstract manner, but can mean thousands of dollars increased income to the producers who take advantage of it. The splendid work of our Gravel Ballast Committee alone can be translated into large sums by members of this association.

"Our association has frequently followed the policies of one of the most successful of trade associations, one closely allied to us, the Portland Cement Association. But let me call your attention to the fact that in order to accomplish so much they now consider it good business to invest each year about 2½ per cent of the net value of their sales of Portland Cement in their association work while the activities of their association are carried on with less than one-fourth of 1 per cent of our net sales, but one-tenth the rate of the cement association.

"How much national advertising to promote the intelligent and increasing use of portland cement or how much of their research work could be done should their revenue be reduced to the same rate as our own?

"I know of no other trade association that has accomplished so much of value to its membership at so little cost. The reason for this is that we have in Washington a small but effective group of employees and in addition many thousands of dollars in time and expense are donated each year by interested members.

"With the changing attitude of government toward trade association and with the better understanding of the public and then more general participation in large business, many see a rapid increase in the importance of such associations.

"One very keen observer of the trend of national events, tells me that in his opinion within a few years every important industry in this country will be dominated and controlled largely by its trade association. Every unnecessary over expansion of an industry and every wasteful price war so apt to follow must be controlled in the interest of the public.

"If in the future this and other trade associations are conducted on sound principles with due consideration for all parties, then it becomes most logical that they should be charged with the full responsibility for the conduct of all industry."

The report of the executive secretary, T. R. Barrows, was not read at the meeting but was printed in the convention program. In it Mr. Barrows pointed out the accomplishments during the past year laying special stress on the work of the Washed Gravel Ballast committee and the cooperation of the association with the Federal Specification Board, charged with the duty of preparing standards for all branches of government purchasing in federal aid road work. After discussing the Western Rate case, Mr. Barrows told of the personal service rendered members in such matters as income tax, car supply, leasing of government docks and dredges, patent office information, etc.

The executive secretary said he was convinced that the railroads were redoubling their efforts to bring about the cancellation of the "combination rule" and warned the members to be on their guard. He advised producers to write officers of the lines serving their points stating their opposition to the cancellation and emphasizing that before their consent could be obtained the carriers must publish a full line of through or proportional rates which reflect the basis obtained by the combination rule.

He also advised watching all tariff schedules and if an attempt at cancellation was discovered requesting the Interstate Commerce Commission or state railroad commission to suspend the effective date of the tariff.

He recommended for the coming year the inauguration of an advertising campaign to emphasize the advantages of properly prepared sand and gravel and the publication of several pamphlets.

The president's address was followed by a talk by George E. MacIlwain of Boston, on "The Outlook for the Next Six Months." He quoted liberally from the forecasts of the various business services on prospects for commerce in general and the conditions in the building industry. While optimistic for the immediate future, Mr. MacIlwain was cautious as to conditions after August 1. He felt certain that the momentum gained in 1925 had not been headed and would carry on for the first three months of this year at least. The impulse gained here he believed would hold out until the first of August at least.

Anything that could happen to the building industry, he said, would be counter balanced by the steady increase of road building. The speaker

got a laugh from the audience when he told how many funerals of the automobile business he had attended and announced he had faith in the vision and ability of the men heading the industry to meet any emergency which might arise this year.

The railroads would be heavy buyers this year, he believed, and although the buying power of the farmers would be a little less he conceded, it was his opinion that any pessimistic predictions as to their future had to be viewed with caution as the troubles were largely sectional. The speaker placed much emphasis on the encouraging European situation which he described as "better than any time since the treaty of Versailles."

There was no strong tendency toward the lifting of money rates, he said, and there was every indication that there would be plenty of capital and loans for sound financing. Prices he considered stabilized, and predicted that the level would be about the same next June as now. Mr. MacIlwain expressed the belief that wages were entirely too high as compared with prices pointing to the fact that they were now 137 per cent higher than in 1913, while the price level was in the seventies. He warned his listeners against the economic dangers which might be brought on by heavy installment buying and warned the operators against over expansion.

W. M. Weigel, mineral technologist of the U. S. Bureau of Mines, followed the statistical-economist with a paper on, "Special Sands as By-products of the Average Commercial Plant." This paper is reprinted in full in another section of this number.

E. W. Dienhart, general manager of the Acme Concrete Products and Gravel Company, Cement City, Michigan, presided at the afternoon session which was a meeting of the Concrete Products Division. The session was well attended and was one of the most lively of the convention.

Mr. Dienhart introduced A. J. R. Curtis, manager of the Cement Products Bureau of the Portland Cement Association.

"Just about sixty years ago two stone masons in one of our large midwest cities made the first concrete blocks," said Mr. Curtis. "At the same time two immigrants coming to America started the first concrete pipe plant that was a commercial success. Since that time there have been remarkable changes.

"This industry has been allowed to shift for itself and, until five years ago, it had never had a great amount of scientific study. Five years ago Mr. Dienhart assisted in making a survey of the concrete building products and we found that 50,000,000 blocks were being used in the United States that year. The following year there were 175,000,000, the next, 285,000,000, and in 1925, 605,000,000—more than twelve times the output in 1920.

"The department of commerce report on the production of common clay brick shows 7,158,000,000; the output of concrete block in the United States in 1925 was 7,865,000,000. You can see that in the short space of a few years this industry has been brought up to where it compares with the old established brick industry, which has been the standard building material. The reasons for this are not obscure."

Mr. Curtis said there had been manufactured to date 605,000,000,000 concrete blocks and that houses built of these blocks and put on 50-foot lots would extend 4,700 miles.

"We dominate the rural communities, so far as masonry is concerned," Mr. Curtis continued.

"You might think that because this industry has, in a few years, reached a point where it is running neck to neck with the clay brick industry, that the possibilities for the future might be limited, but this is not so. In the house field, all masonry houses only go into something between 11 and 14 per cent of the houses built at the present time; the rest are built of frame.

"I want to point out a few reasons why we have been successful in introducing concrete masonry units in construction.

"First, the desire on the part of the Portland Cement Association, feeling a responsibility toward the industry, to get to the bottom of this, discover the principles upon which it could be built. We devoted $11,000 to it. This work started in not only making commercial analysis but trying to find out how a concrete block should be made. In that work over seventy meetings were held in arriving at a standard of quality.

"The next job, was to turn ourselves to discovering scientific methods in developing a fixed-quality product at the lowest possible cost. The six

principles upon which we depended for doing that was (a) to watch and study the great issue of the aggregate, proper gradation; (b) see that we used the right amount of water; (c) the proper amount of cement; (d) right amount of mixing; (e) efficiency of the moulding or casting process; and (f) efficiency of curing methods. These six points are the ones which control the quality of concrete masonry.

"We have gone far enough to know how to control these six factors and then we can control quality. Consequently, we are able at the present time to manufacture in these plants standard quality materials, and the quality is uniform.

"By quality I mean, compressive strength, suction, cutability, and some other qualities of that kind.

"If the dimensions are kept uniform it is possible to design very closely. If the dimensions and the sizes are kept uniform, the units are very much easier to handle, quicker to lay, quicker to lay the mortar and stucco; they require no culling. Right straight down the line, uniformity is the one thing which is making friends for concrete masonry units everywhere.

"One typical quality which we have succeeded in making uniform and which is opening the way to much larger things is suction. We have been talking recently about the absorption of these units, being the amount of water the unit would absorb if immersed twenty-four hours, and the gain in weight while under water would measure its absorption. In reality, when we are able to make a block of tile which is strong enough to pass the requirements we are unlikely to get the material so that the absorption would raise to a higher figure, but what we are interested in is that the suction should be right. The importance of getting the suction right is this: When you are laying your blocks in the mortar they blend properly. When you start to put on stucco it takes it uniformly—same suction one part of the wall as in any other. That is impossible with any other material.

"I believe that we are just seeing the dawn of a stucco era. Architects are using brick; we are accustomed to seeing it, but brick really do not satisfy the demand in many particulars. The darker colors are sombre, dull, morose, compared with lighter and brighter colors which you can get so easily with good stucco. You can get any color in any texture you want in stucco.

"There is a demand and opportunity for many of you men to get into the concrete products business as an outlet for some of your material. Four-fifths of the plants in the country are inconsequential; the other fifth manufactures more than 80 per cent of the product at the present time. You can't make any money by going into it on a small scale, but if you are in a locality that isn't being well serviced at the present time you owe it to yourself to make a survey of the possibilities. There are a number of such localities."

In the discussion which followed Mr. Curtis stated that there was no measure of suction, but that a block could be immersed in water for twenty-four hours, and if it did not absorb more than 10 per cent of its weight it could be assumed to be all right for taking stucco. He said the clinker block had great possibilities because of its light weight and that metal would live in the block indefinitely.

Mr. Curtis was followed by Eugene F. Olsen, general manager of the Anchor Concrete Machinery Company, who traced the development of the industry from its infancy. He told of the old style machine with its laborious hand tamping process its side face and the hand removal of the cores. In those days the aggregate was made with fine sand a great deal of cement and as little water as possible. "The significant thing," he said, "is that practically all these real early cement block jobs are in good shape today."

The next period of the industry was the advent of the cement staved block, which absorbed water and quickly discolored or crumbled away.

The industry revived with the return to a substantial block of high quality and the advent of the down face type of machine and this was followed by the stripper machine. Mr. Olsen gave a thorough description of the modern types of machines and dwelt on the advantages of each type. He painted a rosy future for the industry.

C. C. H. Thomas of the National Stone Tile Company, followed with a talk on "The Sales Angle of the Concrete Products Industry:"

"There is a way of expressing this to you gentlemen that will give you

an idea of what there is in the concrete products field for you by answering a question that I have had put to me many times by men in the industry—how much money is there in this business? Roughly allowing $1.00 to $1.50 a yard delivered at a concrete products plant which is in close proximity to your gravel bins, allowing an average price for cement, average price for labor and considering current practices, including depreciation on the plant, the cost of bulk concrete products runs from $6.00 to $8.00 per yard of gravel. I want you to understand by that, that for every yard of gravel that is turned out, refined, into concrete products, that the cost is from $6.00 to $8.00 per yard. The price that you are able to obtain for that product ranges from about $12.00 to $15.00 per yard. Your profit lies in that margin. I am speaking now of bulk products; I know nothing of ornamental products, garden furniture, etc. But from my experience, sale of pipe, etc., reducing that cost further it figures out from ⅜ to ½ cent per pound of finished material. That is one of the guides that I use in finding out whether a man is getting what he should for his product. If he gets over that and his manufacturing costs are commensurate, we know that he is enjoying something above the average."

The remainder of the time was taken up by Mr. Dienhart in a talk on "Aggregate Requirements of the Concrete Products Industry."

"Estimates compiled by the Portland Cement Association show a production of 600,000,000 concrete building units for the year 1925," said Mr. Dienhart. "Over 12,000,000 tons, or approximately 240,000 cars of sand, gravel and crushed stone were required to produce that quantity of units. In addition, the requirements for other concrete products such as sewer pipe, drain tile, silo staves, trim stone and roofing tile consumed a very large tonnage of sand, gravel and stone. It is safe to say that at least 400,000 cars of aggregate were used for the manufacture of concrete products in 1925.

"At present much of this tonnage is obtained from local pits producing bank-run materials. There is, however, a definite trend toward the use of washed and screened materials and each year finds more products manufacturers employing aggregate from commercial producers of washed and screened sand and gravel.

"In our own plant I will venture to say that in the next two years we will be out of the general field of sand and gravel as most of our producers find our market. I am going to specialize in preparing aggregates for the manufacture of concrete products because this data which has been compiled definitely proves that our pea-gravel—¼ to ½ inch—which around most of our plants is a nuisance and about which we are fighting with highway officials all the time is of value. I find I can prove that it is worth from $6 to $8 per ton. It is worth that much because its use in concrete will reflect that equivalent in saving of Portland cement to make a concrete product of a given strength. I wish that more of us would study that field and go into it.

"Of the 600,000,000 units made last year it took 12,000,000 tons of sand and gravel to produce. Probably 11,000,000 were of sand and the rest gravel. This industry needs small pebbles."

The speaker dwelt the aggregates must be clean and acceptably graded. Humus and decaying vegetable matter have a destructive effect upon the strength of concrete even in small quantities, he pointed out, and washed aggregate as furnished by the sand and gravel producers throughout the country is generally free from harmful matter.

Mr. Dienhart told of tests made at Lewis Institute to determine the strengths of building time. The gradings of the aggregate were varied by using different proportions of number 0 to number 4 sand and number 4 to ⅜ inch roofing pebbles. A strength of 1,280 pounds to the square inch was obtained by a mixture of 50 per cent sand and 50 per cent pebbles using one part of cement and five parts of aggregate while to obtain the same strength using sand alone it was necessary to use three parts of aggregate to one part of cement. From this was reduced the rule that a one to five properly graded mixture gave as strong building tole as a one to three poorly graded mixture.

The annual dinner dance was held Wednesday evening with J. L. Shiely as master of ceremonies. Mr. Shiely announced that he and the ladies were giving the entertainment and that he had been a vociferous critic of the tameness of past performances and

had been handed the job of running this year's dinner as a result of his repeated complaints.

His success as a master of ceremonies was admitted by all who attended. After a dinner interrupted by the awkward actions of "a new waiter" who wound up his performance by the ejection from the ball room of Earl Zimmerman of Cincinnati, it was discovered that the "waiter" was an entertainer and that the Cincinnati producer was "in on the frame." The jazz orchestra took the place of the regular musicians and the frolic was on. Sandwiched in between the dances were a liberal number of professional acts.

The Thursday morning session was opened by a paper by E. Earl Glass, general manager of the Pacific Coast Sand and Gravel Association, on "Selling Sand Gravel and Rock by the Ton Versus Guessing by the Yard."

Mr. Glass opened his talk with a description of the disorganized condition of the industry in southern California until the formation of the association. A few months ago, he explained all was chaos but now organization has led to cooperation.

"One of the first steps we took," said Mr. Glass, "was the establishment of tons instead of yards as the selling basis. No half way measures were resorted to, the leading producers just announced that on a certain date all deliveries would be on that basis. Some opposition was encountered but the rock men stood firm and in a short time the better class of contractors realized that the new basis was to their advantage. Under the old method trick competitors had the edge over the legitimate producers who were trying to maintain a high standard.

"Los Angeles now has an honest weight ordinance which provides that the producer must furnish the customer with a certified weight ticket.

"Regarding sand delivered so wet that water is still running from it is is evident some weight has been lost since it went over the scales but this is negligible as compared with the accompanying loss to the buyer from bulking if the measurement were by volume instead of weight.

"The reason for this is simple for with each pound of water added to dry sand a swelling action takes place which reaches a maximum of about six per cent. This is because each particle becomes coated with water of quite appreciable thickness compared with the diameter of a grain of sand."

Mr. Glass was followed by Earl Zimmerman, chairman of the Washed Gravel Ballast committee who read the report dealing with the five meetings held with the American Railway Engineering Society. The report is given below in part:

"As a result of our efforts and of the splendid cooperation of the General Ballast Committee of the A. R. E. A. a specification for size and grading of gravel railroad ballast has been prepared, which we believe will be to the advantage of all producers in the United States and Canada. as well as to that of the railroads. This specification, which will be described below, probably will be adopted as a tentative standard for one year by the American Railway Engineering Association at their general meeting next March. The General Ballast Committee of that Association expects to continue their researches on this problem during the ensuing year. They will determine upon provisions for factors other than size and grading, such as abrasion, toughness etc., and they hope to create a complete specification which will be adopted as the Standard of their Association. It is the opinion of your Committee that the tentative provisions for size and grading will be included in the Standard Specification without important changes.

"The American Railway Engineering Association will, of course, have the final decision as to the nature of the specification adopted and our work was necessarily, therefore, in close cooperation with their General Ballast Committee.

"The A. R. E. A. is composed of engineers engaged in construction and maintenance of railways throughout North America. The personnel of their 25 or 30 standing committees is composed of engineers of the highest standing and their General Ballast Committee ranks high among them.

"Your Committee wishes to express its appreciation for the splendid cooperation accorded us by the A. R. E. A. Committee. Its members showed an unusual interest in building a specification for gravel ballast which would be suitable to the producers of sand and gravel and at the same time meet the requirements of the railroads.

"The principal requirements for railway ballast may be summarized

as follows: (a) Adequate initial drainage, (b) Support for track structure, (c) No upheaval by frost, (d) Adequate cushion for track, (e) Absence of harmful quantities of fine sand, dust, dirt or loam to insure a dustless roadbed, (f) Of such nature as to permit bringing the track to the proper line and grade with a reasonable expenditure of effort and at a minimum expense.

"In the past gravel ballast has been attacked by producers of other ballast materials and by certain Railway Engineers on the basis that it was responsible for a dusty track when fast trains were moving. Some railroads, we believe, have made 'A Dustless Roadbed' a feature of their advertising; the ballast named in that connection was not gravel. Our proposed specification on Gravel Ballast precludes the possibility of a dusty roadbed due to the ballast, and should do much to counteract such discriminatory advertisements. To the mind of your Committee it guarantees a dustless roadbed more conclusively than any other kind of material being used today.

"Attacks based on dusty roadbeds have been to a great extent, however, the result of a misconception. The principal sources of dust are road and street crossings at grade, streets, upon which tracks are located through cities and towns, highways parallel to the railroad and similar sources. Fast moving trains create a tremendous suction which draws in the dust from the surrounding territory. The result is the same, needless to say, with whatever ballast used. We can state as a fact that clean gravel ballast containing as much as 20 per cent of sand finer than one-tenth inch creates no more dust, if as much, than other kinds of material.

"The specification for gravel ballast, which follows, was evolved after a thorough consideration of the nature of gravel deposits throughout the country, the nature and general methods of producing sand and gravel, and the kinds of machinery in use. It should be emphasized that at no time did the representatives of the railways show a disposition to dictate a specification on any other basis.

"During our first few Joint Meetings it was agreed that, on account of the great variations in gravel deposits throughout the country, it was not practicable to adopt a single universally applicable specification, except to govern general conditions such as cleanness, foreign matter, top and bottom sizes, range of intermediate sizes, etc. It was considered practicable, however, to fix a standard or ideal specification to guide the producer and the railway engineer. Our conception of such a specification is given below and it seems to your Committee that it is so flexible, provides for such variations in maximum and minimum quantities of certain sizes and for the addition of varying amounts of crushed material, that all producers can manufacture a ballast satisfactory to the railroads if his deposit is worthwhile for anything else.

"Following is that portion of the general specifications for Washed, Screened and Graded Gravel Ballast pertaining to size and grading, adopted by the General Ballast Committee of the American Railway Engineering Association.

Where Crushed Material is from 0 to 20 per cent

1/10"	to	¼"	Min. 25%	Max.	40%
¼"	to	½"	Min. 20%	Max.	30%
½"	to	1 "	Min. 20%	Max.	60%
1 "	to	1½"	Min. 0%	Max.	35%

Where Crushed Material is from 20 to 40 per cent

1/10"	to	¼"	Min. 10%	Max.	30%
¼"	to	½"	Min. 20%	Max.	35%
½"	to	1 "	Min. 20%	Max.	60%
1"	to	1½"	Min. 0%	Max.	50%

Where Crushed Material is more than 40 per cent, and not less than 95 per cent is retained on a ¼-inch screen

¼"	to	½"	Min. 20%	Max.	35%
½"	to	1 "	Min. 25%	Max.	60%
1 "	to	1½"	Min. 5%	Max.	55%

Note—Grading to be governed by laboratory tests using screens with circular openings.

Note—A General rule will recite that 98 percent shall pass a 1½ inch circular opening and that the tolerance of sand under 1/10 inch will be 3 per cent.

"In addition to our work on the specifications for size and grading, arrangements were made to submit to the railway engineers data of tests for abrasion and toughness of gravel, from which they could formulate requirements to be incorporated in their complete specification. Provisions for abrasion and toughness were suggested by your committee for the purpose of pointing out the real value of gravel ballast from a quality stand-

point, to prove to the railroads the real service it would provide and to show that this factor is of first importance.

"It should be unnecessary to point out to producers of gravel ballast, or to those who may enter the field, that your Committee assured the representatives of the railroads that if they would give us a hearing in their conferences on specifications, with a view to making it possible for us to deliver gravel ballast in large quantities, that we would deliver material according to specifications It is 'up' to each individual producer to back your Committee's promise in this respect. If this branch of your business is to grow to the extent that it deserves, you must produce material as nearly as possible in accordance with these specifications."

The ballast committee's report precipitated a lively discussion in which it was brought out that it was the opinion of railroad officials that the ideal ballast must contain crushed material and that there is a decided tendency to get away from sand for this purpose.

In reply to a question Mr. Zimmerman said that the railroad engineers seemed to favor the second set of specifications in his report where the crushed material runs over 20 per cent and less than 40 per cent. One producer who has specialized in railroad ballast during the past year said that two plants had paid for themselves in the first two months of operation.

The nominating committee reported their candidates for the various offices and the whole ticket was elected unanimously. The newly elected officers are:

Hugh Haddow Jr., president, Menantico Sand and Gravel Company; R. C. Fletcher, vice president, J. L. Shiely, treasurer; J. E. Carroll, J. D. Roquemore, George A. Rogers, H. H. Halliday, H. S. Davison, J. H. Blanton and John Prince executive committeemen.

The budget committee reported that $36,400 would be needed to run the affairs of the association during the next twelve months and the figure was adopted with little discussion.

Mr. Prince announced that the newly elected president would not be able to assume his duties immediately as he had been confined to his room with an attack of influenza. At the same time Mr. Prince announced that Secretary Barrows was seriously ill with the same affliction and had been taken to the hospital. The illness of these two men caused the plans for the luncheon of the newly elected officers to be abandoned.

The official maiden appearance before the body of the new research engineer Stanton Walker had to be postponed until the afternoon session. Mr. Walker's paper which took the greater part of the final meeting is given in another part of this issue.

As the program of the morning session was not finished when the convention adjourned for lunch the remainder was carried over. Stanton Walker director of the Research and Engineering division opened the session with a paper "Should the National Association Promote Standard Specifications for Sizes of Sand and Gravel." This paper is printed elsewhere in this issue.

After Mr. Walker's paper those who were in a hurry to get away from Atlanta began drifting from the meeting and the session turned into a family discussion of household problems. The subject changed with every speaker.

It was brought out that there had already been a simplification of specified sizes in the Pittsburgh district and that engineers in that section were now working with three classifications of gravel where a year ago they had used **twenty.**

Mr. Walker announced that he was planning to send out a questionnaire to all members of the association asking what sizes they produced, the kind of sieves used and where and for what reason had any of their material been rejected and numerous other queries. He assured the producers that all information obtained this way would be held in strictest confidence and that it would be used only as a basis for statistics and for aiding the producer who was confronting a difficult problem. Several speakers urged the members to cooperate with Mr. Walker by replying promptly to his questionnaire.

An interesting discussion took place as to the relative merits of screens and the old problem of the square and round mesh seemed to be the chief question of contention. Mr. Walker pointed out that although the American Society for Testing Materials had recommended a square mesh screen as standard with specifications of the exact size of the openings and their

number to the inch there were none manufactured on these specifications as far as he was aware. He added however that the variations of the better screens were so slight from the standard that they did not matter in the eyes of the bureau of standards.

Income taxes bobbed up again and the incoming president was asked to appoint a committee to cooperate with the Pacific Coast Sand and Gravel Association in arriving at a fixed standard of depreciation on machinery. Mr. Glass of the coast association read some interesting figures prepared by the California Association of General Contractors which revealed that tests had proved certain equipment should be credited with 50 per cent depreciation annually. It was the opinion that a continuation of this study would prove that sand and gravel operators were entitled to from 15 to 18 per cent depreciation instead of the 10 per cent usually allowed.

The fineness modulus came up for discussion and although the members were assured it "would not bite" the discussion soon dropped into the limbo from which it probably will not be resurrected until the next convention.

Invitations were received for the 1927 convention to be held in New Orleans, Cincinnati, Los Angeles, Kansas City and Montreal but this will not be decided until later by the board of directors.

The Perfect Classifier

The Perfect Classifier is a machine designed to take the aggregates, after they have come from the screening plant, and give them a thorough scrubbing and scouring. After passing through the Perfect Classifier, the product is practically dewatered and free from all impurities. The principle of separation involved in the use of this machine is based upon the difference in specific gravity of materials. The flotation process is used with a high water level in conjunction with the scrubbing action of two revolving screws.

The machine is constructed of steel and iron throughout. The sides and bottom of the depression box is made up of ¼-inch sheet steel while the end is of ½-inch plate steel and strong enough to support the end thrust bearings. Electrical welding has made the machine water tight. The supporting legs are made of 7 inch channels, securely braced and electrically welded to the box. The end thrust bearings are especially designed with machine finish packing glands to prevent leakage at the lower end of the screws. The bearings are securely bolted in place to support the lower end of the screws. There are 2 $\frac{15}{16}$-inch heavy duty angle bearings equipped with automatic compression grease cups at the discharge end of this machine for supporting the screws. The screws run at a slight difference in speed, resulting in the scouring and scrubbing effect. The counter drive on this machine consists of 2 $\frac{15}{16}$-inch steel shaft equipped with one pair of heavy duty angle bearings equipped with automatic compression grease cups. The counter shaft runs at a speed of 80 to 100 r.p.m. The single machines require 10 to 20 h.p., according to size. The horsepower is doubled when the twin models are considered.

The Perfect Classifier.

The material is fed in at an opening on top of the machine and strikes an adjusted baffle which can be raised or lowered to throw off as much of the undesirable material as possible at the first draw. A partition wall is placed just back of the feed opening and it extends to within a few inches of the top of the screws. After the undesirable material is passed down under this partition it is brought up again in suspension at the central part of the machine and the remaining waste passes off at the second draw which also can be raised or lowered to change the water level to fit all conditions. The water supply pipes are interchangeable.

Limestone For Plants, Animals And Man

By Dr. F. E. Baer

Director of Soils Department, Ohio State University.*

THERE is no fact in science which has been more conclusively demonstrated than that of the necessity for lime in human, animal and plant economy. Many of the ailments of the human race may be credited to a lack of mineral elements in the diet of which calcium is one. Lime enters into the structure of bones and teeth. A diet which is deficient in lime will not produce a normal, healthy child. Similarly it has been shown that if cows are fed a ration which is lacking in lime, they ruin their own bodies in order to secure the necessary amount of this material with which to construct the bones of their offspring. Moving down one step farther to the plant kingdom from which man and other animals secure their food for energy and growth, we do not find a single plant which does not contain considerable amounts of the element calcium, the basic ingredient of limestone.

A few years ago in teaching a class in soil management at the Ohio State University, I ventured the assertion that one could tell from a man's appearance whether or not he came from a limestone country. The class seemed to doubt my ability to do this. Accordingly I looked over the 150 men who comprised the class and selected a long, lean specimen of humanity from their midst and asked him where he was born. To the amazement of the class and my own relief, he admitted that he came from Muskingum County, Ohio, where practically all of the soil needs lime.

Probably one might not always be so fortunate in his choosing. There are tall men; lean men and fat men and men of a variety of descriptions in every locality no matter what the nature of the soil. But it seems reasonable to believe that if the diet of human beings is confined to vegetables, grain and livestock products which have had their origin in acid soils, the effect will in time be apparent in the reduction in their vitality.

There is a legend of American origin which says that a limestone country is a rich country. That has been the experience of our farmers. Not only do the crops grow better and the grass more luxuriantly on such soils, but the livestock are in better condition and put on fat more readily and the people themselves tend to have larger and more muscular frames and more vigorous constitutions. One does not need to test the soil to tell whether or not there is carbonate of lime in it. The nature of the crops, the condition of the livestock and the appearance of the people themselves tell the story. There is no known substitute for lime.

Some years ago the International Harvester Company published an attractive bulletin, with a still more attractive title, which stated that "Folks and Fields Need Lime." In this bulletin, the thesis was developed that the method which most effectively insures that folks will get this lime is that of first putting the limestone on the soil and then eating the products of this limed soil. In other words, the bulletin said that applying limestone to the soil guarantees not only larger yields but crops containing more lime and therefore better suited to the needs of man and other animals. There is nothing wrong with that argument.

Perhaps it would be just as well to feed the limestone to the livestock and to ourselves in tablet form. In fact the effectiveness of mineral mixtures for hogs, grit for chickens and concentrated feeds for cattle may be credited to a greater or less extent to the carbonate and phosphat of lime which these materials contain. But the surest way to guarantee an adequate amount of lime in the food is to sow the seed of those plants which are most sensitive to acid soils and then put on enough limestone to make them grow. This system not only works but it pays. Limestone is one of the cornerstones in the foundation of profitable agriculture.

The recognition of the importance of limestone in agriculture is international in its scope. In Germany, Denmark, the Netherlands, Belgium, France and England, those European countries which produce the highest acre yields and where farmers enjoy the most substantial prosperity, lime in one or another form has long been used. Its value for soil improving

*Presented at the Ninth Annual Convention of the National Crushed Stone Association on January 21, 1926, at Montreal.

purposes was known before the birth of Christ. Since that time there have been recurring cycles of favor and disfavor in which lime has been held. The peaks of its use in Europe were during the early years of the 12th century, again in the 16th, the end of the 17th and the beginning of the 19th and 20th centuries. We are now on the upward trend of a curve to which there should never be a decline.

The explanation of these cycles is to be found in the lack of knowledge concerning the requirements of plants and the peculiar function which lime performs. Lime is not the only chemical substance which has gone through these cycles of popularity and disfavor. Landplaster, a combination of lime and sulfuric acid, was once used in considerable amounts in Europe and the practice was carried over to this country by the German farmers. Benjamin Franklin is reputed to have written with landplaster on a hillside near Philadelphia "This land has been plastered." Later the dark green growth of grass made its use very apparent to the passerby. Most farmers of today have never even seen landplaster. Yet it is interesting to note that the acid phosphate which has been so popular during the last 25 years contains about 50 per cent of this material.

Someone has said that plants are not made of nothing. It might be well to add that neither are they made entirely of any one element. Landplaster contains calcium tied to sulfuric acid. Our modern acid phosphate contains landplaster plus phosphate of lime. Other fertilizers supply nitrogen and potash. The plant further requires iron and magnesium from the soil. A deficiency of any one of these materials reduces the yield of crops. Another and even more important requirement of plants is that the reaction of the soil solution be kept from getting too acid. Controlling the soil reaction is the one important function of limestone. Except as difficultiy arises in this connection, there is little to be expected from its use. Limestone may be said to function primarily in the soil and secondarily in the plant.

A large part of the science of soils has been pieced together during the last 25 years. One of the most difficult problems with which the soil scientists have had to deal has been that of acid soil. That lime was an effective material to apply on such soil has long been known. That it functioned, at least, in part, in destroying soil acids has been understood for more than a century. Edwin Ruffin wrote a series of articles on liming for the American Farmer in 1821 which later appeared in book form under the title of "Calcareous Manures." In this book there is a very good discussion of the importance of marl for correcting soil acidity.

But while it was known that soils on being farmed tended to become acid, little was known concerning the nature of these acids. We are still very much in doubt concerning the nature of the compounds in soils which are responsible for the acid condition which obtains in a large percentage of them. Fortunately, we have an electrometric method which tells us just how acid the soil is and enables us to determine just how much effect an application of limestone has had in overcoming this acidity. Irrespective of the acids in soil, we can determine the total effective acidity at any time. Our problem today is one of finding the answers to two major questions:

1. What are the optimum soil reactions for the several crop plants of the bacteria related to their growth?

2. With what factor or group of factors is the ability of an acid soil to maintain an acid reaction co-related?

The indications are that, in extensive farming, the soil must be brought to the optimum reaction for the key legume crop of the rotation, at least during the period when it is being grown. The sequence may be so arranged that the crops will appear in the descending order as to their sensitiveness to acidity. With this in mind, it is apparent from investigational data now available that the producers of agricultural limestone should interest themselves in encouraging the growing of the lime loving legumes, particularly alfalfa and sweet clover. Whenever the soil has reached a high enough plane of productivity to grow alfalfa luxuriantly (and this is seldom possible on an acid soil) then it will produce high yields of almost any other crop which one might desire to grow if that crop is adapted to the climate conditions which obtain. It is the common practice in northern France and Belgium to grow alfalfa once every 10 to 12 years, the other years being

devoted to grain crops and sugar beets or similar cash crops. This means that each time the alfalfa appears in the rotation, consideration must be given to the problem of liming the soil.

If we assume that ultimately the level of productivity will be raised to that which permits of the successful growth of alfalfa, then we might calculate what the limestone needs to the United States would ultimately be. However, it must be kept in mind that the loss of limestone from the soil through removal in crops is small as compared to the losses of drainage. In fact, acid soils are the rule only in humid climates. In the United States there are large areas of alkali land and other large areas where the rate of evaporation is so high that even though the rainfall is quite abundant, the drainage losses are relatively small. The acid soil belt extends from Iowa to the Atlantic Coast and from the Great Lakes to the Gulf of Mexico with the most acid in the regions of heaviest rainfall.

It is not safe to assume that all of the acid soil in America will be limed in the very immediate future. The South carries on a system of agriculture in which the minimum amount of limestone is required. In fact, limestone is not used to any considerable extent south of the Mason and Dixon line with the exception of a few areas in Kentucky and Tennessee. On the other hand, the consumption of fertilizers is much higher in the South than it is on similar land and for similar crops farther north. It is possible to do without lime if enough fertilizer of the right kind is used and if the less sensitive crops are grown. The South is following that practice.

However, the more or less different systems of soil management of the past will not meet the needs of the future. The exportable surplus of foodstuffs in the United States diminishes each year. It is estimated that our present food surplus would feed about twenty million people. It is expected that our population will increase by that many millions within the next 12 to 15 years. The virgin productivity of our soils has been largely exploited. From now on we must add to the soil fully as much of the essential soil elements as the crops remove, if we are to increase our level of production to meet the needs of a population conservatively estimated to be two hundred million by the year 2040.

Our present level of crop yields is not high enough to give adequate returns for labor and capital invested. It may seem ridiculous now, but one may well question whether it is safe to have too narrow a margin between us and famine. Ireland lost six hundred thousand people when her potato crop failed because of blight. What the corn borer menace may mean to America remains to be seen. Our surplus food supply may be wiped out in a relatively few years. Certainly the population is overtaking the food supply. The Malthusian doctrine again merits consideration. Without question higher acre yields must be produced. For these, a larger use of limestone and fertilizers is essential.

Perhaps the one question which has troubled the limestone producer most is that of fineness. The answer to this question is yet to be given. In general it may be said that the limestone screenings have been most popular in the extensive farming sections of the West while the finely pulverized quicklime and hydrated lime have been more largely used to the East. However, one of our western experimental stations has recently published a bulletin which indicated a belief on the part of the agronomists of that station that the product should be pulverized, to pass a 10 mesh sieve in order to be sufficiently rapid in its effect. On the other hand, there has been an increasing interest in ground limestone in the Eastern states. It must be admitted that there is a degree of fineness beyond which no further increase in efficiency is likely to obtain. The limitation to effectiveness is found in the machinery for distribution and subsequent mixing with the soil rather than in the state or division of the material, after a given size of particles has been passed. Certain types of liming materials tend to undergo further reduction in the state of division when they are applied to the soil. There are the further economic problems of the cost of increased fineness viewed from both the producers' and the consumers' point of view.

If coarse products are to be used, we believe that there are good arguments for applying them on the surface as long as possible before they are plowed under or mixed with the soil. This permits of more rapid disintegration, solution and distribu-

tion than would likely take place if these particles were surrounded on all sides by soil. Very remarkable effects on pastures and young clover have been noted following the use of coarse limestone on the surface of the land.

In the event that the stone contains considerable percentages of magnesium carbonate, fineness is more important than in the case with high calcium stone. There is not much difference between the efficiencies of 100 mesh material from high calcium and the high magnesium stones, but there is considerable difference in the case of the 4 mesh products.

It is our opinion that limestone is more useful and effective in the northern than in the southern part of the United States. Where sessions are short, the process of nutrification needs to be stimulated as much as possible. Limestone is effective in this connection. In areas where the soil is frozen during a large portion of the year, the rate of disintegration and decomposition of soil materials in less than it is where the temperature is more mild. As a result, the critical point in acidity may be reached in colder regions in a soil which if moved farther south would still grow crops satisfactorily without limestone.

In general, we beliece that, once the soil becomes acid, the use of two tons of limestone per acre every 6 to 10 years is necessary for the production of high acre yielding of the more desirable crops. When more food is required, the consumer of this food must expect to pay for that amount of limestone. Assuming that no more than that amount of limestone is to be used, then we believe that most of the products should pass a 10 mesh sieve and that a considerable percentage should pass a sieve with 100 meshes to the inch. In some cases, economic conditions will justify the use of coarser product. In other cases, they will make it necessary to used burned lime. No one rule can be applied to all cases.

A. M. Bates Dies in New York

Abelmar M. Bates, president of the Bates Valve Bag company of Chicago, was fatally stricken with heart trouble on the street in New York. He died in a taxicab while being rushed to a hospital. Mr. Bates and two friends attended a theater and were returning to their hotel when he complained of a pain in the side and collapsed.

Hayward Bucket Bulletins

The Hayward Company, manufacturers of a complete line of excavating buckets, have issued two new bulletins which are of especial interest to users of draglines, clam shells and orange peels buckets. Bulletin number 626, devoted to Hayward buckets for sewers, roads and streets, gives a surprisingly long list of the various models made by this concern. The bulletin touches briefly on dragline buckets and gives complete descriptions of the five models of clam shells which the company offers. These are the Class E regular bowl, Class E with ore bowl, Class G, Class H, and the electric motor clam shell. The Hayward Company offers a wide selection of orange peel buckets, ranging from the standard bucket to the multi-power, three sided, rope reeved, and dwarf orange peel.

The dwarf orange peel is treated more fully in a separate bulletin. This bucket is similar in construction to the larger models put out by the company, using the Hayward closing mechanism and having all the sturdy construction protection wearing parts which characterize all Hayward buckets. They are, of course, hand operated. They are recommended by the company for sinking cylinders and pipes from 12 inches in diameter up, digging wells, cleaning out old wells, cleaning sewer catch basins, digging trench ditches and test pits, etc. They can be used to advantage wherever space is limited. The depth to which they will dig is limited only by the length of the operating lines. Where very compact materials are dug, a hammer or driving weight is provided to help the bucket penetrate.

New Incorporations

Portland Cement Products Corp., New York City. Capital $3,500,000. (Corporation Trust Co. of America.)

Turnpike Cement Block Corporation Co., Inc. Capital $50,000. Directors: Chas. F. Heuther, A. V. Ruff, 23 Flatbush Ave., Brooklyn, N. Y.; G. DiPalma, 114th Ave. and Merrick Road, Jamaica, N. Y.

The Newburgh Sand & Gravel Co., Cleveland, Ohio. Capital $25,000. Incorporations: Antonio and Carmen Lenese, Rose and Charles De More, D. J. Lombardo.

Santa Rosa Cement Company, Wilmington, Del. Capital $8,500,000. Incorporator: T. L. Croteau.

Norris Sand and Gravel Co., Rochester, N. Y.

Special Sands as By-Products

By W. M. Weigel

Mineral Technologist, U. S. Bureau of Mines*

MOST members of the National Sand and Gravel Association are primarily interested in structural sand which is by far the most important kind both from the standpoint of tonnage and value. There are, however, many other grades of considerable importance, some of which would be possible of production at many plants now producing only the standard grades of building and concrete sands. Some of these as for example glass sand, sand for pulverizing and for chemical and metallurgical use require a high silica content and few commercial deposits worked for structural material are of sufficient purity to meet the requirements. There are other grades however where high purity is not so necessary and it is believed that many commercial plants might find it advantageous to turn out one or more grades as by-products.

In nearly all cases it would be necessary to install some additional equipment or make slight changes in the existing flow sheet and the cost of these changes and additional equipment would have to be weighed against the possible returns. Often however these changes would not be expensive and would consist of one or more additional screens with necessary handling equipment and storage capacity to take care of the special grades produced.

When it became necessary to dry the sand, however, the additional cost would be considerable as any kind of drying system that could be installed would be expensive as it invôlves not only the dryer, but foundations, auxiliary equipment and provision for the dryer. It would of course be imperative for the firm contemplating such production first to investigate the market and determine if it would be possible to produce the marketable grades from the sand available. This investigation would include an inquiry of industries within shipping distances which used the sand which could be prepared, the characteristics of the sand used, seasonal requirements, possible outlets for other grades which might be prepared and all other information affecting the market. It possibly would also mean a careful laboratory study of the sand produced including chemical analysis and microscopic study of the character of the individual sand grains and the character of the impurities.

One interesting possibility for the commercial sand plant would be where the grade normally produced contained an excess of grains between certain limiting sizes as specified for structural purposes. For example, the American Society for Testing Materials gives tentative specifications for fine aggregate as follows:

Passing ⅜ in. sieve—100 per cent
Passing No. 4 sieve— 85 per cent
Passing number 50 sieve—not less than 30 per cent
Weight removed by decantation test —not more than 3 per cent

The commercial sand being prepared might contain considerably more than 55 per cent between the number 4 and the number 50 sieve. In this case it would be possible to take out part of this and utilize it in the preparation of some special sand. Again there might be more than 30 per cent finer than number 50 sieve, in which event the removal of this excess would improve the grade of the main product and this excess might be used for some special purpose. The A. S. T. M. tentative specifications state that no more than 6 per cent shall be retained on a number 8 sieve. In case a sand contained in excess of this amount the excess could be screened out and used for some special purpose, for example, the two coarser grades of sand blast sand. The Bureau of Public Roads recommends specifications for sand for concrete roads that are quite elastic as, for example, it is stated that the proportion between a number 10 and a number 50 sieve may vary from 50 to 90 per cent. Most special sands fall within these limits so that a preponderance of any close range of sizes within these limits would permit the separation of a considerable portion without, in any way, impairing the

*Published by permission of the Director of the Bureau of Mines as a paper presented before the Tenth Annual Convention of the National Sand and Gravel Association on January 20, 1926, at Atlanta, Georgia.

value of the sand for concrete purposes.

While moulding sand is not usually considered a special sand there are so many kinds and varieties of this material that I am sure some commercial sand plants could produce some of the grades. In fact plants are now in operation where part of the output is marketed as core sand or steel moulding sand. These, of course, are washed grades. Most moulding sands for work other than steel moulding are not washed and their value depends on the natural bonding material in the sand, usually a ferruginous clay. Is it not possible that some commercial deposits may have parts of the bed, such as positions of the overburden or underlying beds that are unsuitable for structural sands but might make a good moulding sand? The American Foundrymen's Association is carrying on an investigation of moulding sand including the collection of information on available sources of both producing and new deposits. Samples of sand which are believed to be of value for moulding may be sent to their research committee for examination.

There are two general ways in which special sands may be prepared as a by-product or a secondary product at a commercial plant. In the first method a portion of the entire natural sand product is cut out, usually after it has been washed, and special sand prepared from this. In the second method only part of the sand between certain limiting sizes is cut out from the natural product. Occasionally a combination of these two methods may be used. The first method would be employed where several grades of special sands are prepared and a range of sizes from coarse to fine desired, or where the special sand made was itself a product graded from coarse to fine as some of the abrasive sands like stone sawing and some glass grinding sands. In this method less careful control is required in the first separation from the principal plant product as it does not in any way affect the quality or grading of that.

The second method would be less frequently used and would be applicable only where one or two grades of closely sized sands were desired and where there was an excess of grains of this size in the natural sand. More careful control of operations is required, especially if only a part of the grade within the limiting sizes is to be removed. Natural sands to which this method would apply have been referred to. An Ohio plant is a modified example of this. Coarse and fine gravel are washed out on vibrating screens, and the oversize from the last vibrating screen is diverted to separate bins and is a source from which sand blast sand and special marble and stone sawing sand is prepared. This material has all passed a $\frac{3}{16}$-inch square mesh screen and the clay, fines and moulding sand removed on a finer screen.

Special Sand Which May Be Prepared

High silica sands usually cannot be prepared at the ordinary commercial plant but some of the more important which might be produced are, filter sand, sand blast sand, stone sawing and glass grinding sand, engine sand, flooring sand and various grades of abrasive sands. A brief description of the uses and properties of these different sands may perhaps be of interest.

Engine sand is one which is produced in large quantities and finds use wherever railroads operate. Many of the smaller railroads take what is available without much regard for quality. The better managed roads, however, are careful to specify material suitable for the purpose. The sand should be a washed product, free from foreign matter and any clay coating which might tend to absorb moisture. An excessive amount of fines is objectionable as they blow off the rail and tend to absorb moisture and form lumps. Coarse grains are objectionable as they are liable to choke the supply pipes. A sand high in silica is considered best. Most of the sand used is sharp to medium sharp, but rounded grain sand has been successfully employed. Sometimes the railroads and street car companies take wet sand, preferring to do all the drying themselves but many roads buy dry sand. One large railroad company uses sand at least 97 per cent of which will pass a number 20 sieve, with not more than 10 per cent passing a number 80 sieve. Another large railroad uses a sand all of which passes a number 10 sieve, with 40 per cent retained on a number 40 sieve and not more than 5 per cent passing a number 80 sieve. At one plant engine sand is made from the fine material screened from sand blast sand. Specifications in most cases are not rigid and many commercial sand

plants could easily prepare a satisfactory product.

Filter sand is used in various types of filters for the purification and clarification of water, especially for municipal water supply. Not only is silt and sediment in the water removed mechanically but a good sand filter also removes most of the bacteria. While the total production is not large, about 120,000 tons per year, the best grades command a good price and it can be prepared from most commercial sands of good quality as the chemical requirements are not particularly severe. The physical properties as usually specified appear formidable at first sight and it might seem that the preparation of the sand was a difficult and expensive operation, but this is not the case. The fineness is usually specified by a figure called the "effective size" which means an arbitrary size expressed in millimeters such that 90 per cent is coarser than this and 10 per cent finer, or in other words the size of the opening in an imaginary sieve which would retain 90 per cent of the sand. The grading from coarse to fine is specified by a figure called the "uniformity coefficient." It is an abstract quantity and is the ratio of the size of grain which has 60 per cent finer than this to the size which is 10 per cent finer (or the effective size). If all the grains were exactly the same size the uniformity coefficient would be 1. The effective size varies from 0.20 to 0.70 millimeters (0.008 to 0.028 inch), or about number 70 to number 25 U. S. standard sieve. The more common sizes are, however, from 0.35 to 0.55 millimeters, number 45 to number 35 standard sieve. The uniformity coefficient varies from 1.25 to 1.80 with 1.55 to 1.65 as an average. A sand then with an effective size of 0.42 mm. and a uniformity coefficient of 1.40 would have 90 per cent retained on a number 40 sieve (0.42 mm.) and 40 per cent retained on a number 30 sieve (0.59 mm.). It is also usually required that at least 90 per cent shall be finer than 2 mm. or pass a number 10 sieve, and all pass a number 4 sieve. It is usually specified that the sand must be clean and free from clay and organic matter, a requirement easily met by any good sand plant, also that not more than 5 per cent shall be soluble in hot dilute hydrochloric acid. Lime and magnesia, calculated as carbonates, must not be present in excess of 2 per cent. Practically all plants which produce sand blast sand can prepare filter sand as the requirements are much the same as for number 1 blast sand, for while some large grains are permissible most filter sands will all pass a 14 to 20 mesh sieve as it is not necessary in most cases to remove most of the coarser material from ordinary sand to get the desired uniformity. Both rounded grain and sharp sand is used.

Sand blast sand is usually classed as one of the abrasive sands but as it is of commercial importance and has special properties it is here considered as a separate product. While at first used mainly in the foundry to smooth up rough castings it now finds application in many other lines of industry. Some of its uses are, the removal of old paint from wooden surfaces, renovating or cleaning the outside walls of stone buildings, carvings and lettering on stone, marble and granite, finishing iron and steel preparatory to enameling, finishing brass and bronze castings, giving special ground glass finish to plate glass, and numerous other purposes.

Blast sand must be closely graded, perfectly dry, and of fairly high silica content. For this reason it brings a better price than any of the other grades of special sands.

Sand for stone and marble cutting and grinding and for glass grinding is one of the special sands of considerable importance, the total production probably being in the neighborhood of two million tons per year, with an average value of about $1.60 per ton. There are no definite specifications covering this grade as each consumer looks for a sand which meets his particular requirements, and the ideas of the different consumers are not the same. Price and availability are more often determining factors than otherwise. In general the sand should be fairly pure, free from excess fines and large grains, and made up mostly of tough quartz grains. Some consumers use a uniformly sized sand similar to sand blast sand when it can be cheaply obtained but most of the material used is a product graded from coarse to fine. Almost any good commercial sand plant could produce a satisfactory stone sawing sand if the product does not contain too high a percentage of grains which are not quartz. A large marble company satisfactorily uses a sand for sawing and rubbing of the following sizes: Pass-

ing number 8 sieve, 100 per cent, retained on number 30 sieve 20 per cent, retained on number 50 sieve 85 per cent, passing number 100 sieve 2 per cent. A large plate glass company uses a grinding sand all of which passes a number 20 sieve with 80 per cent retained on a number 100 sieve and 2 per cent passing a number 200 sieve. It takes about three tons of sand to grind a ton of plate glass. Both rounded and angular grained sands are used.

Flooring sand, as here considered, constitutes part of the aggregate in asphalt mastic flooring which consists of a sand and fine mineral filler aggregate with asphalt cement binder. As far as tonnage goes it is not an important grade. No chemical analysis is specified but the sand should be clean and free from clay and silt. It should all pass a number 3 sieve, with a maximum of 60 per cent through a number 8 sieve and not more than 8 per cent passing a number 100 sieve.

There are other special sands used for many industrial purposes, most of which are of rather minor importance and it usually would not pay to make special preparation and install extra equipment for their preparation. In many cases they are ordinary sands used for some special purpose and given a corresponding trade name.

The producer of structural sand, unfamiliar with the preparation and marketing of other grades, may well raise the question as to the desirability and practicability of investing in new equipment and being bothered with the additional supervision required to prepare special gradés, but as the cost of mining or excavating and preliminary washing and screening are not in any way increased, a knowledge of the difference in price obtained for the two classes should certainly cause a more careful study to be made of the possibilities. In 1924, the average selling price at the plant for building and paving sands was about 56½ cents per ton while that for the group including filter, engine and all forms of grinding and polishing sands was about $1.10 per ton or nearly twice that of the commercial grades.. If sand could be sold for the former figure at a profit, and we must assume that the average plant operated at a profit, then even the additional cost of special preparation should leave a still better percentage of profit at the higher figure.

It is sincerely hoped that some of the suggestions given regarding the possible production of special sands at the ordinary commercial plant may lead to a more careful study of the possibilities and ultimately to a profit by any one taking it.

Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trade-mark attorney, Continental Trust Building, Washington, D. C., at the rate of 20 cents each. State number of patent and name of inventor when ordering.

1,565,281. Agitator for gyratory mills. William T. McNinch, Chicago Heights, Ill., assignor to American Manganese Steel Co., Chicago, Ill.

1,565,811. Loading apparatus (drag-line scraper). Joe W. Morrison, Akron, Ohio, assignor to Sullivan Machinery Co., Claremont, N. H.

1,565,883. Screen. Alfred L. Adrianson and Axel L. Bengtson, Racine, Wis.

1,565,892. Screen. Alfred L. Adrianson and Axel L. Bengtson, Racine, Wis.

1,566,030. Power-shovel construction. Isidore Marks, Dorchester, Mass., assignor to Keystone Mfg. Co., South Boston, Mass.

1,566,031. Dump-body truck. Isidore Marks, Dorchester, Mass., assignor to Keystone Mfg. Co., South Boston, Mass.

1,566,133. Sand-mixing apparatus. Howard L. Wadsworth, Cleveland, O.

1,566,301. (Loading) skip-elevating mechanism. Raymond A. Beckwith, Milwaukee, Wis., assignor to Koehring Co., same place.

1,566,437. Dipper - door - locking means. James A. Simpson, Chicago, Ill.

1,566,498. Process for making waterproof Portland cement. Charles N. Miller, San Francisco, Cal.

1,566,585. Power shovel and dredge. George R. Dempster, Knoxville, Tenn.

1,567,075. Tipple-screen cleaner. James S. Pates, Pittsburgh, Pa.

1,567,077. Tumbling mill. Louis D. Peik, Cleveland, Ohio.

Developments In The Asphalt Industry With Relation to Crushed Stone

By Prevost Hubbard

Chemical Engineer, The Asphalt Association.

FOR many years past a greater yardage of asphalt roads and pavements has been constructed in the United States than of any other type of pavement of higher quality than water-bound macadam. From data at present available we have estimated that during 1925 not less than one hundred forty million square yards of asphalt pavement, greater than the combined yardage of all other high type pavements, were constructed on the various state, county and city highway systems, and this figure does not include roads which were merely surface treated with asphalt or asphaltic oils, of which there was also a large yardage. The great majority of these asphalt pavements contained commercial crushed stone, and in a considerable proportion crushed stone products constitute from 40 to 100 per cent of the total mineral aggregate in the asphalt paving composition.

It is impossible to ascertain accurately the tonnage of crushed stone products consumed in this work, but a rough and probably very conservative estimate may be made by assuming that crushed stone was in about two thirds of this yardage to an average extent of 50 per cent by weight. If an average thickness of 2½ inches is assumed for the asphalt pavement proper, exclusive of foundation, with an average weight of 250 pounds per square yard, the quantity of crushed stone products used for such work in 1925 would be figured at over eleven million tons. What proportion of the 1925 production of crushed stone this figure represents I do not know as the latest government statistics are for 1924. It does, however, amount to about one sixth of the reported tonnage of crushed stone for 1924. Foundations for asphalt pavements of course also consume a very large tonnage of crushed stone; but if our present consideration is limited to wearing courses only, it is evident that the crushed stone and asphalt have much in common.

A paper presented at the Ninth Annual Convention of the National Crushed Stone Association at Montreal on January 19, 1926.

In this connection let us review the statistics of production of both industries during recent years. Taking production during 1919, the first post war year, as 100 and plotting the annual production of both industries to 1924, it will be found that their growth curves correspond quite closely. Thus in 1923 both showed an index of about 185 which was considerably higher than of other highway material industries, with the exception of gravel. From the figures at present available, the 1924 production indexes of both are higher than for any of the others, amounting to 200 for crushed stone, and about 239 for asphalt. The nearest competing highway material to asphalt shows a 1924 index of 174. The asphalt industries continued to grow in 1925, and an estimate of production during that year gives an index of about 260. Prospects for 1926 indicate a decided continued growth and I venture to prophesy that this growth will materially boost the production of crushed stone. Thus if the average rate of growth for asphalt pavements during the past six years is projected into the future, an annual increase of not less than one million tons of crushed stone products required for the construction of this increased yardage, should follow.

So far we have considered only asphalt pavements proper which are standard types of wearing courses with an assured place in the nation's highway construction program. In addition there are thousands of miles of waterbound macadam roads which must be maintained with surface treatments of asphalt, asphaltic oils or other bituminous materials to justify their existence or future construction for even moderate traffic. Statistics compiled by the U. S. Bureau of Public Roads showed that on January 1, 1922 there were over nineteen thousand miles of surface treated macadam on the rural highway system of the United States and that during 1922 some six hundred thirteen miles of such roads were constructed. These are the most recent available figures which are authentic, but if annual construction of the same

additional mileage is assumed for 1923 to 1925 inclusive, the total of such rural roads at the present time would be about twenty-one thousand miles. A considerable yardage of similar roads exists within the corporate limits of nearly all of our cities; and while no reliable information on the subject is apparently obtainable, it is believed that such construction will total not less than five thousand miles. As a basis for this estimate it may be stated that on January 1, 1923 a census of paving types in cities representing about two thirds of our urban population showed approximately eight thousand miles of combined waterbound and surface treated macadam. If the estimated urban mileage of surface treated macadam is added to the rural mileage, a grand total of twenty-six thousand miles is obtained.

A considerable proportion of such roads is maintained with annual surface treatments of bituminous material and a covering of small size crushed stone. If, however, an average period of two years is assumed between treatments and only half of the total mileage is credited to treatment with asphaltic products, it is readily seen that some 6,500 miles of macadam roads are so treated each year. On the basis of an average width of fifteen feet the amount of crushed stone cover required for this surface treatment can be figured at about one and one half million tons annually.

From the foregoing it would appear then that not less than twelve and one half million tons of crushed stone products are used annually in the construction of asphalt wearing courses and surface treatments. In addition through normal growth of the asphalt industry an increased consumption of not less than one million tons of crushed stone may be expected each year. And this does not take into account crushed stone used in the construction of foundations for these asphalt highways. Crushed stone used in foundation construction for asphalt pavements is very difficult to estimate. An unknown proportion of the yardage of asphalt pavements is constructed on existing old roads which are thus utilized as foundations with or without an increase in thickness. Moreover, there are a number of types of foundations in connection with which no data is available as to the relative amounts of crushed stone and gravel consumed. Taking everything into consideration, however, it is believed that approximately the same amount of crushed stone is annually used in the construction of foundations for asphalt pavements as in the pavements themselves so that on this basis the total consumption would be about double the figures already given.

With this admittedly crude attempt to develop some of the existing highway requirements of mutual interest to the crushed stone and asphalt industries let us turn our attention for a few moments to prospective new developments in highway construction which may also prove to be of mutual interest, and well worth cooperative effort in their furtherance.

For a number of years past a flexible type of foundation known as black base has been extremely popular in a number of our western states. The term black base has been applied to them because the mineral aggregate is bound together with asphalt. These black base pavements have a remarkable service record; and as their intrinsic merit has been conclusively proven over a long period of years, the Asphalt Association is much interested in furthering their more extensive use in other sections of the country. Eastern engineers are becoming much interested in this type of construction and during the past three or four years quite an appreciable yardage of black base pavements has been laid in the eastern, central and southern states and in Canada.

The design of such pavements ordinarily recommended by our Association calls for an asphaltic concrete base three or three and one half inches thick with an asphaltic concrete or sheet asphalt wearing course two or one and one half inches thick so as to produce a total thickness of asphalt mixture of about five inches. Such a thickness of asphaltic concrete with broken stone coarse aggregate requires over twenty-three hundred tons of crushed stone products per mile of road twenty feed wide. This is more stone than would be used in an hydraulic cement concrete road of 1:2:3 mix with an average thickness of over seven inches as against the five inch thickness of the asphaltic concrete pavement.

Now while the black base pavement itself should be of considerable interest to your Association for reasons just indicated, there is another feature connected with them which in my opinion offers considerable opportunity for utilization of certain crushed stone products which are at present most difficult to market.

Standardized Specifications for Sizes of Sand and Gravel

By Stanton Walker

Director, Engineering and Research Division, N. S. G. A.

STANDARDIZATION is the slogan of modern industry. The need for it is pointed out in a report of the Chairman of the American Engineering Standards Committee for 1925 where it is stated that approximately 27,000 specifications exist for only 6,000 commodities. There is little doubt but that the multiplicity of standards for sand and gravel aids materially in bringing the average number of specifications for each commodity up to more than four. Most sand and gravel producers manufacture sizes and gradings of material slightly different from those of his neighbor. The different classes of material produced seem almost to have been chosen haphazardly.

The responsibility for this rather unsatisfactory state of affairs rests chiefly with the specification writer. Until very recently each engineer who used sand and gravel seemed to feel called upon to write his own specification, and these were generally not written with material produced locally in mind, but rather to conform to the ideas—sometimes good and sometimes not—of each engineer on what would best suit his needs. This resulted in almost as many specifications as engineers and the sand and gravel producer did his best to furnish materials to meet them. The engineer should not be blamed too severely, however, for his apparent inconsistencies; they were caused by lack of information on what constituted suitable material.

During the past several years much good work has been done toward the standardization of specifications for sand and gravel and similar materials; notably by the American Society for Testing Materials, the American Concrete Institute, various State Highway and City Engineering Departments and our own Washed Gravel Ballast Committee. Specifications proposed by such bodies as these tend to promote the manufacture of standard sizes of sand and gravel. That a great deal more work along these lines is needed cannot be doubted. The exact details of this work, just how far it should go and where it should stop, must be worked out carefully, in order that its consummation will be for the ultimate economy to the public as a whole.

The purpose of this paper is not to attempt to settle at this time the question of what should be done in the matter of standardization of sizes of sand and gravel, but rather to invite discussion of the subject in the hope that information will be brought out which will be helpful to that end.

Standardization of Sizes of Sand and Gravel

The term "size" is often used loosely to refer to the grading or classification of sand and gravel more definitely than to its actual dimensions. For example, material for reinforced concrete work is often referred to as 1-inch gravel, and means aggregate graded from 1 or 1¼ inch down to perhaps ½-inch, ⅜-inch, ¼-inch or whatever may be the local custom. In this paper "size" refers to screen of sieve sizes used for separation at the plant and for specifications of grading. It is not at once obvious why one producer should make one of the top sizes of his gravel 1-inch while another producer, perhaps, in the same town, has 1¼-inch for his top size. No good reason is at once apparent why Committee C-9 on Concrete and Concrete Aggregates of the American Society for Testing Materials should base their recommendations for sieve analysis of aggregates on the square mesh sieves shown in Table 1, while Committee D-4 of the same Society should recommend slightly different square mesh sieves for fine material and screens with circular openings for coarse material.

Sieves for Analyses of Aggregate

Sieves recommended by Committee C-9 of the American Society for Testing Materials in "Standard Method of Test for Sieve Analysis of Aggregates for Concrete.

*Paper presented at the Tenth Annual Convention of the National Sand and Gravel Association, Atlanta, on January 21, 1926.

Table 1.

Sieve Number[1] or Size in inches	Sieve Opening		Wire Diameter		Tolerance, per cent — Wire Diameter			
	mm.	in.	mm.	in.	Average Opening	Under	Over	Maximum Opening
No. 100	0.149	0.0059	0.102	0.0040	6	15	35	40
No. 50	0.297	0.0117	0.188	0.0074	6	15	35	40
No. 30	0.59	0.0232	0.33	0.0130	5	15	30	25
No. 16	1.19	0.0469	0.54	0.0213	3	15	30	10
No. 8	2.38	0.0937	0.84	0.0331	3	15	30	10
No. 4	4.76	0.167	1.27	0.050	3	15	30	10
⅜-inch	9.5	0.375	2.33	0.092	3	10	10	10
¾-inch	19.0	0.75	3.42	0.135	3	10	10	10
1-inch	25.4	1.00	4.12	0.162	3	10	10	10
1½-inch	38.0	1.50	4.50	0.177	3	10	10	10
2-inch	50.8	2.00	4.88	0.192	3	10	10	10
3-inch	76.0	3.00	6.3	0.25	3	10	10	10

[1] The requirements for sieves No. 100 to No. 4 conform to the requirements of the U. S. Standard Sieve Series as given in U. S. Bureau of Standards Letter Circular No. 74. The liberal tolerances will permit the use of certain sieves which do not exactly correspond to the numbers given in the table.

Standardization of these features is undoubtedly desirable. There seems to be no economic or technical reason why there should not be uniformity in this respect. Time will bring it about, but time will be greatly aided in its work if the members of the National Sand and Gravel Association will lend their help.

When a local specification for sand and gravel is being drafted, let each producer in that territory interest himself in seeing that a standard set of sieves is used. For this purpose, the square mesh sieves suggested by Committee C-9 of the A. S. T. M. and adopted by the Joint Committee on Concrete and Reinforced Concrete is recommended for your consideration. (See table 1.) While it might be difficult to point out in what way this set of sieves is greatly better than others recommended by equally competent agencies, it does represent a standard, and probably the one which has been most generally adopted throughout the country. These sieves, at least those finer than ⅜-inch, were suggested by the U. S. Bureau of Standards after a careful study of the subject. They have the advantage of a logical and systematic arrangement of sizes. A study of the table will show that, except for the 1 and 2 inch sieves, the clear opening of each sieve is double that of the next smaller one. Another reason for the use of these sieves is that they facilitate the computation of the fineness modulus, which will be discussed briefly further on in this paper.

The selection of standard sieve or screen sizes for use in the manufacture of the product and the "bin sizes" which each manufacturer should produce is a part of the same problem. All manufacturers cannot, obviously, produce all sizes, but those which he does produce should conform as nearly as possible to some accepted standard. Perhaps the recommendations of the Joint Committee on Concrete and Reinforced Concrete for size and grading of coarse aggregate, which will be discussed below, will serve as a basis for constructive thought along these lines (see Table 3).

It would seem desirable for the National Sand and Gravel Association to appoint a committee to study the question of standardization of manufactured sizes of sand and gravel as well as of sieve sizes used in specifications for grading. If such a committee is appointed, the Engineering and Research Division will be glad to cooperate with it in every way possible.

Standardization of Grading of Sand and Gravel

The standardization of grading of sand and gravel does not permit of as ready a solution as that of sizes. This should, in general, be an independent problem in each locality. It should have no other basis than a thorough study of the sand and gravel produced in the respective localities. To specify gradings which would necessitate wasting too large a proportion of the natural deposit would be economically unsound. What constitutes "too large a proportion" can be determined only from a careful study of the grading of the material and the effect of variations in the grading on the quality of the work in which it is to be used.

Such a study will be greatly facilitated by the standardization of manufactured sizes of sand and gravel.

An example of the confusion caused by the lack of uniformity in manufactured sizes in one locality was experienced recently during the preparation of specifications for aggregate for a large public works to be erected in a prominent city. The engineer in charge of writing the specifications collected and tested many samples of sand and gravel from work under way, in an effort to obtain information which would enable him to prepare an intelligent specification for grading which could be met economically by the established producers in that locality. The manufactured product which he sampled varied over such a wide range, particularly in the case of the coarse aggregate, that it was only with extreme difficulty that a satisfactory specification was evolved.

While connected with the Structural Materials Research Laboratory of the Portland Cement Association, I was called upon in numerous instances to assist in the preparation of specifications for aggregate for concrete. In such cases the paramount question was always—"What is the nature of the material produced in that locality?" This question cannot be ignored if the work is to be done on a sound economic basis. Do not understand from this that any letting down of the bars on "quality" is being recommended. The most rigid control of the uniformity of the grading, which can be attained only in a well designed manufacturing plant, is essential if proportions of materials which will give the desired quality are to be selected intelligently.

A convenient form of specification for grading of sand is that recommended for fine aggregate for concrete by the Joint Committee (see Table 2). The percentages in the table are not a part of the specification but it is recommended by the Committee that they be used wherever practicable.

Selection of Grading of Agregate

A brief discussion of methods of selecting the most economical grading of aggregates for concrete should be of interest at this time. In the field of concrete, where of course the greatest amount of our material is used, researches carried out in the past few years have provided definite information which furnish a basis for the selection of proportions. Professor D. A. Abrams has conducted at the Structural Materials Research Laboratory what is undoubtedly the most comprehensive series of investigations which have ever been carried out on concrete aggregates. The results of his investigations, which have been confirmed in all of their essential features in many other laboratories, have furnished us with two extremely valuable tools to assist us in the intelligent use of our material —sand and gravel.

These are the "water-ratio" method of proportioning concrete and the "fineness modulus" method of measuring the grading of aggregate. Time permits of only a most limited discussion of these factors.

Water-Ratio.—The water-ratio method of proportioning concrete has for its basis the fact that the strength of concrete is fixed by the quantity of mixing water expressed as a ratio to the quantity of cement. So long as the concrete is workable and the aggregates are clean and structurally sound, the quality of cement, the consistency or plasticity of the concrete, and the grading of the aggregate affect the strength of the concrete only in-so-far as they affect the quantity of mixing water required. The gen-

Table 2. Grading of Fine Aggregate

Passing through No. 4 Sieve	not less than 85 percent by weight.
Passing through No. 50 Sieve	not more than 30 percent by weight.
	and not less than 10 percent by weight.
Weight removei by recantation	not more than 3 percent by weight.

Table 3 gives sizes and gradings of coarse aggregate recommended by the Joint Committee which should furnish a convenient form for specifications and offer some suggestions for selection of standard sizes.

Table 3. Size and Grading of Coarse Aggregate

Nominal Maximum Size of Aggregate, in.	Percentage by Weight Passing through Standard Sieves with Square Openings						Percent. Passing, not more than	
	3 in.	2 in.	1½ in.	1 in.	¾ in.	½ in.	No. 4 Sieve	No. 8 Sieve
3	95	..	40–75	..	..	..	10	5
2	..	95	..	40–75	..	..	10	5
1½	..	..	95	..	40–75	..	10	5
1	..	..	..	95	..	..	10	5
¾	..	..	..	..	95	..	10	5
½	..	..	..	..	..	95	10	5

eral recognition of this fact will be the greatest boon to the established sand and gravel industry that has ever occurred, as will be demonstrated, it is hoped, in what follows.

Since the essential factor in concrete, so far as the strength and similar features are concerned, is the water-ratio, it follows that it is this factor which should be most definitely specified, instead of the proportions of cement, sand and gravel. Provisions for limiting the quantity of mixing water occupies a prominent place in all modern specifications. Still more definite limitations are desirable and in at least one specification (proposed by F. R. McMillan and myself in a paper before the American Society of Civil Engineers in October of last year) the water-ratio, expressed as gallons of water per sack of cement, was the only factor of the proportions which was specified. This specification was successfully put into practice on a reinforced concrete job in Chicago.

Such a specification at once places a premium on uniform well graded sand and gravel aggregates and points out their advantages more forcibly than has ever before been the case. The contractor at once learns that it is not feasible to operate under such a specification unless he receives materials, the uniformity of grading of which can be depended upon. Immediately fluctuations in the grading occur, the workability of the concrete varies over such a wide range that the proportions must be changed. Such changes not only hopelessly interfere with the routine of the job, but also make the question of costs of materials so uncertain that intelligent bids can not be made. Therefore dependable, uniform materials are essential, and can be obtained only from established producers, such as those who compose the membership of this Association.

Under this form of specification, well graded materials will be insisted upon as never before. The better graded the aggregate the less cement will be required for a given water-ratio and condition of workability, and economy will demand the use of the best graded material available. And I venture the opinion that gravel aggregates will be given preference as never before because its well known advantages with respect to workability will not only permit greater economy in handling but may also permit the use of more economical mixtures.

The water-ratio method of proportioning concrete, therefore, offers a ready means of determining what proportions of sand and gravel will be most economical.

Fineness Modulus. The fineness modulus method of measuring the grading of aggregate is a most useful corollary to the water-ratio method of proportioning concrete.

The fineness modulus is the sum of the percentages in the sieve analysis divided by 100, when the sieve analysis is expressed as percentages coarser than the sieves in Table 1, except the 1 and 2 in. sieves. For a complete discussion of this factor see Bulletin 1 of the Structural Materials Research Laboratory, "Design of Concrete Mixtures" by Duff A. Abrams. Brief discussions are also given in the June and July issues of the National Sand and Gravel Bulletin.

Coarsely graded aggregates are indicated by a high fineness modulus, fine, poorly graded aggregates by a low fineness modulus. Within the limits of workability the quantity of mixing water required for concrete decreases, and hence the strength increases, as the fineness modulus increases.

Professor Abrams points out that for the range of conditions in which we are principally interested the quantity of mixing water in concrete is governed by the fineness modulus, and that therefore differently graded aggregates which have the same fineness modulus have equal concrete making properties. This factor becomes therefore a most valuable tool in comparing the relative merits of different gradings of aggregate, and has great possibilities as a basis for specifications.

The fineness modulus should also prove useful in solving problems of the industry aside from those connected with concrete, but that is a phase which will not be discussed at this time.

Other Measures of Grading. The surface area, the surface modulus, voids, and fixed sieve analysis (Fuller's curve for example) have been proposed as measures of the grading of aggregate. All of these methods possess merit. However none of them permit of as simple application as the fineness modulus, nor have the relations been worked out so completely.

Fire Hazards of Stone Crushing Plants

By D. C. Souder

Director, Insurance and Safety, France Stone Company*

BETTER supervision must be employed in our plants if we are going to reduce our fire losses. In discussing the subject of fire hazards as related to stone crushing plants, the structural makeup of these plants, the operation and fire hazard and the fire protection afforded the average plant should be considered.

The crusher plants are largely tall frame structures of so-called "balloon type construction." Fires originating therein will naturally spread at a very rapid rate due to the combustible materials used in construction and the numerous vertical openings, such as stairways, elevator openings and belt holes which go from floor to floor. The vertical openings act as flues and aid in the rapid spread of fire. Shingle roofs are dangerous and should not be countenanced under any condition, no roof at all is better than a shingle roof.

The fire hazards are principally those of power, such as steam, electricity, gas, and fuel oil. Power arrangements should be confined to incombustible or fire resistive structures cut off in proper manner from the crusher building and other buildings. If power buildings are of combustible construction, such as brick with wooden roofs, they should be well detached from the crusher plant with a minimum distance of 40 feet.

Electric power is the safest form of power in a plant of this kind, if properly installed and proper supervision given to motors. All wiring should be in conduit due to the possibility of the breakage of insulators and barking of wire insulation and derangement of wires caused by falling or flying rocks, falling or leaning tools, addition or removal of boards or timbers to the building and other similar causes.

In steam power plants, boilers should be set on concrete floors with ample lateral and vertical clearance to combustible walls and roofs. Metal stacks, where passing through combustible roofs, should have 18 inches clearance.

Where a gas engine is used, magneto or battery ignition should be used rather than hot tube ignition which still exists in some plants. The gas regulator device should be of a cast iron type with a rubber bag inside and should be vented to the outside. The water sealed tin can regulator is not a very satisfactory device due to its flimsy construction and the natural tendency to corrode.

In case of oil engines, main supply of oil should be buried outside and pumped to engine with shut-off valves provided in feed lines at engine, pump, and at tank. All piping should drain back to the tank. The Underwriters' requirements, as I now recall them, make provisions for a relief valve to by-pass the oil back to the tank in event of a rupture of the line.

Elevator legs in the crusher plant should preferably be of incombustible material—that is, metal. Bearings should set on incombustible blocks rather than wooden ones which are likely to become oil soaked and a great source of danger if hot bearings should occur.

Approved waste cans should be provided for oily waste and rags. One man in your plant should be assigned to the duties of oiling machinery and motors. Motors, whether of A-C or D-C type, should be blown out frequently—not only from the standpoint of fire hazard, but also from the standpoint of economy.

Locomotive sparks can always be considered a source of danger, especially from plant owned engines which are usually called upon to carry loads beyond their capacity, and in addition, combustion is generally poor which results in excessive sparking. Smoking by employes should not be tolerated under any conditions.

I wish, at this particular point, to call your attention to the fact that the protection of your fire hazards should not be considered in a passive light—but, one that is vital to your interests. The proper supervision of your plant is essential in order to reduce fire losses to a minimum, which, of course, means keeping your production at a maximum point. No honest man ever benefited by a fire. In fact, the best he can get is a draw.

Most of the plants are isolated from

A paper presented on January 19, 1926 at the Ninth Annual Convention of the National Crushed Stone Association at Montreal.

public fire protection and, in consequence, it is necessary to depend on private fire protection devices. By far the majority of fires start on a small scale and if proper devices are provided to combat these conditions, fires should readily be controlled if discovered in an early stage.

The two and a half gallon approved extinguisher is a very desirable fire extinguishing feature. However, if sufficient quantities of water are available, a stand pipe system with hose at each floor level can be considered desirable if a fire pump of adequate size is installed to convey the water at a proper pressure. There are, however, drawbacks to the latter system as I see it and that is the fact that hose must be given very careful attention so it does not deteriorate to such an extent as to make valueless in event of a fire. Also, some delay might be occasioned in getting water due to the fact that water cannot be allowed in the pipes during winter months, due to the possibility of a freeze-up. Altogether, the chemical extinguishers are the most economical and probably the most practical.

During a fifty year period from 1875 to 1925, the property loss in this country has increased from $78,000,000 per annum to over $500,000,000. This is a sad state of affairs when you consider that this property can never be replaced and I am sure that you can visualize what a terrific drain this will prove to be if fire losses are not greatly reduced in the future. It is not possible for even as rich a country as this is to lose physical property to the extent that we have been and not suffer at some future date. Even in our business, I find that loss ratios are excessive. I have just learned that one of the large fire insurance companies in this country has paid out approximately $1.09 for every $1.00 they have taken in on the insurance of stone crusher plants.

Fire has a far reaching effect. I find that 43 per cent of the plants or business enterprises that are destroyed by fire are never rebuilt. 14 per cent lose from 30 to 67 per cent of their credit standing.

Harnischfeger Sales Corporation, distributor for Harnischfeger Corporation, announces the location of a branch office at 808 Guaranty Building, Indianapolis, Indiana. J. H. Enochs is the district manager in charge of the office.

New Thew Gasoline Shovel

Interest was shown at the Chicago Road Show in the new gasoline shovel and crane which has just been introduced to the trade by the Thew Shovel Company. The boom construction is unusual because of the absence of mechanisms. Here the utmost simplicity of operation has been achieved; one shaft, one pinion and a driving sprocket. The boom structure too is novel and interesting.

Remarkable simplicity and directness of power application has been achieved by driving the three operating shafts with one drive pinion which distributes the power, load and strains of wear in three directions. Each shaft is called upon to transmit only a minimum of power. There are no long trains of gears or complicated mechanisms on the entire machine.

The machine is controlled by three levers. Unusual ease of control is secured partly by employing unusually large diameter friction clutches and partly by utilizing engine power for controlling frictions. While this machine has the power, range and working capacities of a 1¼-yard machine it requires no more clearance for house, rear-end swing or boom radius than the ¾-yard size and weighs but little more. It is mounted on the Thew Center Drive Truck.

This new Thew shovel is known as the Lorain-75. The manufacturers say it is brought out to answer a demand for a gasoline machine which possesses the reliability, flexibility and ease of operation of the modern steam shovel. With motor trucks taking the place of dump wagons for hauling the manufacturers felt that a shovel which would have a larger dipper capacity and still remain a light machine was needed.

The engineers decided that the new Lorain-75 must not be a modification of the old shovel but an entirely new design. New methods were employed for the direct application of power to work.

The new shovel weighs 65,000 pounds and the crane with a 40 foot boom weighs 60,000 pounds. For average digging it will take a 1¼-yard dipper and a 1 yard dipper for rock. The boom is 21 feet long. Clamshell or dragline buckets from ¾ to 1¼ yards can be used depending upon the length of the boom and the kind of work done. The engine is either a 75 h.p. Waukesha or Buda. For electric drive a 40 h.p. motor is used.

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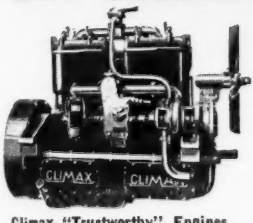

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1—Model 80 Marion. Shop No. 1312, 4-yd.
1—Model 75 Marion. Shop No. 2112, 2½-yd. or 4-yd. dipper.
1—70-C Bucyrus. Shop Nos. 1197, 2½-yd. dipper.
4—70-ton Bucyrus. Shop Nos. 920, 939, 977 and 1233, 2½-yd. dippers.
5—Model 60 Marion. Shop Nos. 1301, 1995, 1999, 2059 and 2238, 2½-yd. dippers.
2—60-C Bucyrus Shop Nos. 1286 and 1388, 2½-yd. dippers.
1—45-C Bucyrus. Shop No. 1201, 1¾-yd. dipper.

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1—80-B Bucyrus Caterpillar Type Steam Shovel. Shop No. 4002—New November, 1923. Equipped with 41-ft. 6-in. boom, 26-ft. dipper arm and 2½-yd. dipper. Located Madisonville, Ky.
2—Model 31-Marion. Shop Nos. 3341 and 3613, 1-yd. dipper. Traction wheel or railroad truck mounting.
1—18-B Bucyrus. Shop No. 1870, ⅞-yd. dipper. Traction.
3—Type "B" Erie. Shop Nos. 1989, 2084 and 2144. Steel Caterpillars. High lift boom, long dipper arms with ¾-yd. dippers. Power boom hoist. Located Verdigris, Oklahoma.
3—Type "B" Erie. Shop Nos. 1219, 1484, 1880, Caterpillars, high lift, ¾-yd. dippers.
1—Model 21 Marion. Shop No. 4294, steel caterpillars, standard boom and dipper arm, ¾-yd. dipper.
1—Type O Thew. Shop No. 1777, traction wheels, high lift equipment, 2/3-yd. dipper. A.S.M.E. boiler.
2—Model 104 Northwest Gasoline Shovels. Shop Nos. 213 and 263. Caterpillars, standard boom and dipper arm with ⅞-yd. Manganese dipper. Located Verdigris, Oklahoma.

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30—16-yd. Western Cars, with vertical dump cylinders and automatic lock, box-girder doors.
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16—12-yd. Western Air Dump Cars. 19-ft. beds, box girder doors. Vertical cylinders.
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2—12-yd. Western Hand Dump Cars, 19-ft. beds, box girder doors.
3—12-yd. Oliver Hand Dump Cars.
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6—6-yd. Western, std. gauge, wood sills, Truss rod doors, automatic couplers.
11—6-yd. Western St. Gauge Steel Sills, wood beds, truss-rod doors.
18—6-yd. Continental, std. gauge, Steel sills, truss-rod doors.
21—1½-yd. Western, 24-in. gauge.
23—4-yd. Western, 36-in. gauge, steel sills, truss rod doors.
6—8-yd. Western, 36-in. ga., double trucks, box-girder doors.

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3—Mead-Morrison 1½ yd. Clam Shells.
2—1¼-yd. O. & S. Coal Loading Clam Shells.

STEAM SHOVEL PARTS

All repair parts on hand for Model 60 Marion and standard 70-ton Bucyrus Steam Shovels.
1—5-yd. Dipper for 95-C Bucyrus Shovel.
1—Boom for Marion 60 or 61 Shovel, length 35-ft. 22-ft. dipper arm, 1½-yd. dipper, long jack arms, etc.
1—19-ft. 6-in. boom. 12-ft. sticks and ditcher bucket for Type B Erie Shovels.
1—22-ft. dipper stick for Type B, Erie Shovel.

LOCOMOTIVES—24-in. Gauge

3—7x12 Davenport Dinkies. Shop Nos. 1202, 1411 and 1524. Weight 9 tons.
1—6x10 Davenport Side Tank Dinkey. Shop No. 1307. Weight, 7 tons.
1—7x12 Vulcan Saddle Tank. Weight 9 tons.
1—6-ton Whitcomb. Shop No. 1259. Gear drive. Gasoline.

LOCOMOTIVES—36-in. Gauge

1—11x16 Davenport four-wheeled Saddle Tank. Shop No. 2027. New in 1924. A.S.M.E. boiler, 170 lb. pressure. Steam brakes.
1—11x16 Porter, four-wheel Saddle Tank, Shop No. 6717. New 1922. A.S.M.E. boiler. 170 lb. steam pressure.
1—9x14 Vulcan Dinkey. Shop No. 1675. Weight, 14 tons.
2—7x12 Davenport, 4-wheel Saddle Tank. Shop Nos. 1566 and 1567.

LOCOMOTIVES—Standard Gauge

1—19x24 Baldwin 6-wheeled S. T. Shop No. 49553, built 1918. Weight 67-tons, air brakes, 180 lbs. steam pressure.
1—17 x 24 Davenport 6-wheeled switcher with tender. Shop No. 1269. Steam pressure 180-lbs. Weight 47-tons.
1—16x24 Davenport 4-wheeled Switcher. Shop No. 858, weight 38 tons, 170 lb. steam pressure. Located Verdigris, Oklahoma.
1—16x24 Baldwin 4-wheeled Switcher. Shop No. 34631. Weight 39 tons, 180 lb. steam pressure. Located Verdigris, Oklahoma.
1—16x24 Vulcan four-wheeled Switcher, with tender. Shop No. 1764. Steam pressure 180-lb. Weight 40 tons.
1—11x16 Davenport 4-wheeled Saddle Tank. Shop Nos. 1938 and 1951. New 1923. A.S.M.E. boilers carrying 170 lb pressure. Steam brakes. Electric headlights.

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2—Class 24 Bucyrus, Shop Nos. 858 and 859. Steam self-propelling trucks, 100-ft. booms, 3½-yd. Page buckets, electric lights, coal hoists. Located near East St. Louis.
1—Class 20 Bucyrus. Shop No. 813. Skid and roller, 85-ft. boom, 3-yd. Page bucket.
1—Class 14 Bucyrus. Steam operated. Shop No. 748. Caterpillars. 60-ft. boom, 2-yd. Page bucket.
1—Monighan No. 2. Shop No. 789. Skids 60-ft. boom, 2-yd. bucket.
1—30-B Bucyrus. Shop No. 3641. Caterpillar. 40-ft. boom. 1-yd. bucket.
1—Model 210 P&H Gasoline Dragline. Shop No. 1077 Armored caterpillars. 40-ft. boom, 1-yd. Page bucket.
1—Model 4 Austin Caterpillars, 40-ft boom. Shop No. 112. New in 1923.
1—Complete Caterpillar arrangement for Class 14 Bucyrus Dragline equipped with armored tread.

CRANES

1—Model 102 Northwest Gasoline. Shop No. 102. 40-ft. boom. Bucket-operating. Located Verdigris, Oklahoma.
1—Type "B" Erie. Shop No. 929. Caterpillars. 36-ft. boom. Bucket-operating, ¾-yd. clam shell.
1—Type "B" Erie. Shop No. 559. Traction or railroad truck mounting. 32-ft. boom. Bucket-operating.
1—10-ton Industrial, 4-wheeled. Shop No. 1989, 40-ft. boom, bucket operating.
1—15-ton Brown Hoist, 42-ft. boom.
2—23-ton Type "B" McMyler. Shop Nos. 2015 and 2108. 40-ft. booms, bucket-operating.
1—15-ton Ohio. Shop No. 3441. 8-wheeled, M.C.B. trucks. 40-ft. boom, with 10-ft. extension, bucket-operating drums, 1-yd. bucket.
1—25-ton Industrial, 8-wheeled. Shop No. 3261. Bucket-operating, 55-ft. boom, with 20-ft. extension.
1—25-ton Browning, 8-wheeled. Shop No. 1560. 50-ft. boom, bucket-operating drums and 1½-yd. Mead-Morrison clam shell bucket.

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DERRICKS

Large quantity late model American Stiff Leg Derricks, mast 14x14x40 ft. booms 14x14x60 ft., stiff legs, 14x14x50 or 60 ft. sills if desired, with 12 ft. steel bull wheel, for hook work or bucket operation.

Large quantity late model American Stiff Leg Derricks, mast 16x16x40 ft., booms 14x14x80 ft., trussed with hog rods, legs and sills 14x14 with 16-ft. steel bull wheel, arranged for hook or bucket operation.

Also several Guy Derricks, wood or steel, arranged for single line work or for operating clam shell bucket.

CABLEWAYS

11—3 and 5-ton, Street Bros. (Howson) Cableways, complete with automatic dump buckets.

COMPRESSORS

1—2-stage, 950 ft. Sullivan, Class N.B. Compressor.

1—2-stage, 1,500 ft. Sullivan, stationary Compressor.

2—Chicago Pneumatic Portable gasoline driven, on rubber-tired wheels, cap. 210 cu. ft.

CRANES AND SHOVELS

1—15-ton O & S, 8-wheel M. C. B., 40-ft. boom, bucket operating.

1—O & S 7-ton Crane, 30-ft. boom, ¾-yd. clamshell bucket, traction wheels.

1—Byers Auto Crane, 30-ft. boom, ¾-yd. bucket, traction wheels, steam.

2—Thews on traction wheels, 1, Type A1, 1, Type 0.

BOILERS

3—Walsh Widener, 150 H.P. H.R.T. Boilers.

82—Upright Boilers, ranging in size from 30" in diameter by 60" high, to 48" diameter by 120" high. These boilers are suitable for mounting on concrete mixers, all high pressure. We have some boilers suitable for low pressure work, such as heating materials, at very low prices.

1—225 H.P. Bigelow-Manning, size No. 8. Vertical.

LOCOMOTIVES

1—Davenport std. ga. 20-ton, 10x16 cylinders, saddle tank. No. 1497.

2—Porter std. ga. saddle tank, 14x22 cylinders, weight 42 tons, like new, only one year of service, shop Nos. 6768-6771.

3—7-ton, 24-in. ga., Plymouth, gasoline.

6—3-ton, 24-in. ga., gasoline. 3—Plymouth. 3—Whitcomb Fordson.

STEAM SHOVELS

2—78-C Bucyrus, 1923 model, 30 ft. boom, 19 ft. dipper stick, 3-yd. dipper, on caterpillar. Shop No. 4001 and 4124.

SPECIAL

2—Porter, oil burning, 6-wheel, with tender, cylinders 18x24, weight 105,000 lbs., on drivers, new July, 1925, equipped with Walschaert valve gear, electric lights, air brakes. Can be changed for coal burning at slight cost.

2—Type "B" Erie Steam Shovels, on caterpillars, with crane booms, one equipped with fair leads for dragline work; new 1923 and 1924.

CABLEWAY EXCAVATORS

1—Sauerman 1-yd. Cableway Excavator with 8¼x10 double drum 2-speed hoist, with all necessary cable and sheaves for 1,000 ft. span.

2—Link-Belt Dull Cableway Excavator Buckets; one 1½-yd.; one 1-yd.

STEAM HOISTS

12—Three-Drum Hoists, with or without boilers. Sizes 10x12, 9x12, 9x10, 8¼x10 and 7x10, with separate swingers for derrick work. All makes.

54—Two-Drum Hoists, with or without boilers. Sizes 12x12, 10x12, 9x10, 8¼x10, 7x10, 6¼x10, 6x8, and 5x8. Can be equipped with holding drum for bucket work.

Equipment Corporation of America

PITTSBURGH PA.
860 Empire Bldg.
Phone Grant 5148

CHICAGO, ILL.
1460 Roanoke Bldg.
Phone Randolph 6586

PHILADELPHIA, PA.
660 Land Title Bldg.
Phone Rittenhouse 5948

FOR SALE OR RENT

STEAM SHOVELS

1—70-C Bucyrus. Shop No. 1749. Standard gauge, railroad, 2½-yd. dipper.

1—Model 60 Marion. Shop No. 1463. Standard gauge, railroad 2½ yd. dipper (butt strap boiler).

1—18B Bucyrus, revolving. Shop No. 1764. Traction wheels, ⅞-yd. dipper.

1—Type B Erie Revolving Steam Shovel, traction wheels, standard boom, ¾-yd. dipper.

1—Model 212 Marion (revolving). Shop No. 4620. Mounted on trucks, 55-ft. boom, 34-ft. dipper stick, 1¾-yd. dipper. Only used enough to be broken in; compares favorably with new.

Cranes for Rent Only

20 to 30 ton, 8 wheel, standard gauge locomotive, bucket handling, 50 ft. booms, with or without buckets.

DRAGLINES

1—210 P & H Gasoline. No. 1349, on caterpillars. 76-hp. Twin City Engine, 48-ft. boom, 1-yd. bucket. Burns kerosene oil fuel.

1—Class 14 Bucyrus, steam operated, on caterpillars, 60-ft. boom, 2-yd. Page bucket.

1—Class 24 Bucyrus, steam operated, skids and rollers, 100-ft. boom, 3½-yd. bucket.

1—Class 24 Bucyrus Electric Driven, skids and rollers, 100-ft. boom, 3½-yd. bucket.

DUMP CARS

18—12-yd. Western Hand Dump Cars, Standard gauge.

35—1½-yd. Western, 24-in. gauge, Dump cars.

FOR RENT ONLY

1—20B Bucyrus Revolving Steam Shovel, high lift. Shop No. 4309. Mounted on caterpillars; ¾-yd. dipper.

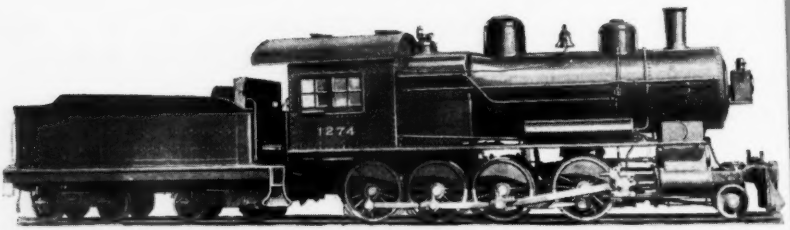
1—Type B Erie revolving high lift Steam Shovel. Shop No. 2777 Caterpillars. ¾-yd. dipper.

The above list is constantly changing. No matter what your machinery requirements are, write us—we may have it.

EARTH & ROCK EQUIPMENT CO.

534 National Life Bldg. Chicago, Ill.

Telephone Randolph 2580



3 Duplicate; 82-Ton; 20x26″ Consolidation Type; Piston Valve; 200 Lbs. Steam; 48″ Wheel Centers; Tractive Power 34,000 Lbs.; Thoroughly Overhauled; I. C. C.

ALSO HAVE OVERHAULED AND READY—

5—75-Ton; 20x26″ Consolidations; 44″ Wheel Centers; 190 Lbs. Steam; Tractive Power 33,590 Lbs.; I. C. C.

3—85-Ton; 20x26″ 12-Wheel Consolidations; Piston Valve; 48″ Wheel Centers; 200 Lbs. Steam; Tractive Power 34,000 Lbs.; I. C. C.

4—92-Ton; 21x28″ Consolidations; Piston Valve; Wide Firebox; 200 Lbs. Steam; 50″ Wheel Centers; Tractive Power 38,000 Lbs.; Some Outside Valve Gear; I. C. C.

1—125-Ton Shay Geared; 200 Lbs. Steam; Tractive Power 53,000 Lbs.; I. C. C.

1—60-Ton; 1924″ 6-Driver Saddle Tank; New Asme Boiler in 1921.

WILL EXCHANGE FOR LIGHTER POWER, ETC.

Have other equipment overhauled and ready

—RELAYING RAIL—

Southern Iron & Equipment Co. Atlanta, Ga.

CRANES

Osgood Caterpillar Combination ¾ yd.
McMyler 25 ton 8 wheel 50-70' Boom.
Browning 15-20 ton 8 wheel 50' Boom.
O & S 12 ton Cat. Gas 50' Boom 1 yd.
Byers Model 10 Cat. Gas ¾ yd. Bucket.
P. & H. 205 Gas 30' Boom ½ yd. Bucket.

SHOVELS

Bucyrus 175B 75' Boom 3½ yd. Dipper.
Marion 76 R. R. Type 3½ yd. dipper.
Marion 37 Cat. Electric high lift.
Marion 36 Cat. high lift 1¼ yard.
Osgood ¾-yd. Caterpillar Combination.
Erie B Cat. ¾ yard.
Erie Type A Cat. ½ and ⅝ yard.
P. & H. 206 Cat. Gas ¾ yard.
Insley Cat. Gas ½ yard.

DRAGLINES

P. & H. 206 Gas 38' Boom.
P. & H. 210 Gas 40' Boom 1¼ yard.
Northwest 40' Boom 1 yd.
Austin No. 5 Combination 1 yd.

CRUSHER & QUARRY EQUIPMENT

Gates Gyratory No. 7½, 5, 4, 3.
McCully Gyratory No. 3.
Allis Chalmers Jaw 36" x 48".
Allis Chalmers Rolls 40" x 15".
Aurora 11x20, portable, Elev. & Screen.
Reliance 10"x16".
Gates Heavy Duty Screen 40" x 20'.
Gates Heavy Duty Screen 60" x 20'.
End Dump Cars 3 yard Stand. Gauge.
Western 12 yd. Cars Air Dump, St. Ga.

Air Compressors, Boilers, Cars, Engines, Generators, Motors and Power Equipment.

F. MAYER

53 W. Jackson Blvd., Chicago, Ill.

STEAM SHOVEL

Bucyrus, 50-B, Crawling tread, 1¾-yd. dipper. New 1925.

DRAG LINE

Sauerman, 100' mast, 9"x10" Hoist, A.S.M.E. boiler, 800' span, 1 yd. Page bucket.

HOISTS

Lambert Tripple drum, Cyls. 12"x14" with boiler mounted and 10"x12" swinger.

Mundy tripple drum, Cyls. 7¼x10" with attached swinger and A.S.M.E. Boiler.

Flory, single and double drum, cableway hoists, sizes 10"x12" and 12"x15".

LOCOMOTIVES

Two, Plymouth, 7-ton standard gauge, gasoline.

LOCO CRANE

Orton & Steinbrenner, 25-ton, 8-wheel, bucket handling, 70' boom, A.S.M.E. boiler, practically new condition.

A. J. O'NEILL CO.

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Philadelphia, Pa.

Phone Rittenhouse 6973

FOR SALE

Bay City ½-yd. Gas shovel.
Farrel Jaw Crushers, sizes 30x36 and 15x36.
Champion Jaw Crushers 12x26 and 10x20.
3—Wet Pans or Chaser mills 8' and 9' sizes.
110' Robbins Conveyor with 30" rubber belt.
Allis Chalmers 20'x48" revolving screen.
3—Newaygo screens or separators. Elevators various sizes.
Davenport 25-ton Saddle Tank, 165-lb. boiler pressure.
2—Plymouth Gas Locomotives 36" gauge, 8 and 6-ton sizes.
2—Plymouth 3-ton, 24" gauge Gas Locomotives.
26—Koppel 1½-yd., 36" gauge cars, 12—Western 3-yd., 36" gauge.
20—Koppel 1-yd., 24" gauge, 16—Koppel ¾-yd., 24" gauge.
21—Western 4-yd., steel sill, 36" gauge cars.
6—K & J, 6-yd. dump cars, std. gauge.
Sauerman 1-yd. and 1½-yd. Cableway Excavators.
90' steel mast for 2-yd. Sauerman Cableway.
2—Atlas 60'x6' rotary Kilns, complete.
1—Atlas 109'x7' Rotary Kilns, complete.
Compressors, Hoists, Derricks, Cranes, Etc.

Central Equipment Co.

602 Owens Bldg. Detroit, Mich.

HIGH GRADE ELECTRIC MOTORS

Gregory Rebuilt give the same service as a new machine, but the price is much lower.

THREE-PHASE, 60 CYCLE MOTORS, 220 OR 440 VOLTS

Qu.	H.P.		Speed
7	25	Westinghouse, type CS	860
1	25	Westinghouse, type CS	690
2	30	Cleveland, type M	3600
1	30	G. E., form M, slip ring	1200
4	30	G.E., form K	900
2	30	Allis-Chalmers, type AN	850
1	30	Allis-Chalmers, type AN	575
1	35	G. E., form M, slip ring	900
1	40	Westinghouse, type CW, slip ring	1160
1	40	Westinghouse, type CW	695
1	40	Westinghouse, MW, slip ring	850
2	40	Westinghouse, CX	580
1	50	Fairbanks-Morse, type BV, slip ring	1200
1	50	Allis-Chalmers, type AN	1160
1	60	G. E., type I, form M, slip ring	900
1	75	Allis-Chalmers, ANY, slip ring	1750
1	75	G. E., TRB revolv. field, synchronous	1200
1	75	Allis-Chalmers, type AN	850
1	75	Westinghouse, CX	850
1	75	Fairbanks-Morse, BV, slip ring	690
1	75	G. E., form K	600
1	75	Westinghouse, CW, slip ring	435
1	100	Westinghouse, CW, 2200 v, slip ring	875
1	100	G. E., form M., slip ring	600
1	150	Electric Machinery Co., synchronous	900
1	200	Westinghouse, CW, slip ring	500
1	250	Westinghouse, CX	850
1	250	G. E., form M, slip ring	514
1	250	G. E., type I, form M., slip ring	385
1	300	G. E., type I, form M, slip ring	1200

Large Stock of 3 hase 25 Cycle, also Direct Current Motors.

Send for our Monthly Bargain Sheet showing Complete Stock—this is only a partial list. **A $500,000 Stock Always Available.** Motors, Generators, Transformers, Bought, Sold and Exchanged.

The GREGORY "Money Back Guarantee and the GREGORY REPUTATION protects you.

GREGORY ELECTRIC CO.

Works: 16th and Lincoln and Wood Sts., Chicago, Ill.

FOR SALE

1 No. 12 K Allis-Chalmers Crusher with spare parts.
1 No. 7½ D Allis-Chalmers Crusher with spare parts.
1 No. 6 D Allis-Chalmers Crusher with spare parts.
1 Allis-Chalmers closed end screen 48"x16'.
1 Allis-Chalmers closed end screen 40"x18'.
1 Sullivan Compressor Class W. J. Duplex 20"x12½"x16".
15 Quarry cars 36" gauge with 4 yard steel skips.
1 Davenport Locomotive 36" gauge 12"x16".
1 American Locomotive 36" gauge.
1 Allis-Chalmers transformer KVA200 HV13000 LV 460 Phases 3 Cycles 25.

DULUTH CRUSHED STONE COMPANY
DULUTH, MINNESOTA

FOR SALE

2—Norwalk Air Compressors direct connected to 12x12 Norwalk Steam Engine. Compressor as follows:

Low 11½x12
High 7½x12
Low 11½x12
High 5½x12

This equipment is brand new and is on original skids. Price $1,000.00 each f.o.b. cars.

OKLAHOMA HIGH LINE CONSTRUCTION CO.,
115 E. Archer Tulsa, Oklahoma

AIR COMPRESSORS

92 ft. Ingersoll-Rand, ER-1, Belted.
355 ft. Ingersoll-Rand, ER-1, Belted.
355 ft. Ingersoll-Rand, FR-1, Steam
528 ft. Ingersoll-Rand, ER-1, Belt.
599 ft. Ingersoll-Rand, Imperial XB-2, Belted.
888 ft. Ingersoll-Rand, Imperial XB-2, Belted.
1190 ft. Ingersoll-Rnad, Imperial XB-2, Belted.
1145 ft. Chicago Pneumatic OCB, Belt.
1400 ft. Chicago Pneumatic, OCB, Belt.
1500 ft. Ingersoll-Rand, Imperial XB-2, Belt.
1270 ft. Chicago, OCE Motor Driven, 3 phase, 25 cycle, 440 volt.
1308 ft. Chicago, OCE Motor Driven, 3 phase, 60 cycle, 2200 volt.
6—212 ft. Chicago Portable Oil Engine Driven Compressors.
Portable Gasoline Driven Compressors.

PITTSBURGH PNEUMATIC MACHINERY CO.
507 Liberty Ave., Pittsburgh, Penna.

FOR SALE

1—Figure 1531, 6x12 Form C Drive, Goulds Pyramid Pump, without motor. Capacity 114 gallons at 175' head.

1—Nordberg Butler Type Shuveloder, in first class running condition.

1—Flory double cylinder, double friction, steam hoist, list No. 87, 6¼"x 8". 12"x20" drums.

OWNED AND FOR SALE BY US

GRAY FOUNDRY, INC., Poultney, Vt.

For Sale—Reasonable

The following used 220 or 440 volt, A.C., 60 cycle motors.

3—7½ H.P. Cleveland ..1800 R.P.M.
1—20 H.P. Cleveland .. 900 R.P.M.
1—30 H.P. Cleveland ..1200 R.P.M.
1—40 H.P. Western Electric ..... 900 R.P.M.
4—50 H.P. Burke Slip Ring ..... 600 R.P.M.

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GENERATORS
We Buy—Sell
REPAIR
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Substitute Motors
Furnished for
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A Fractional HP Motor or a Complete Power Plant

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Every machine completely overhauled and tested—Guaranteed
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CLEVELAND, OHIO

Kilns, Pulverizers, Air Comps.
Crushers #10, 9, 8, 7½, 6, 5, 4, 3,
Roll Crushers
84x72, 36x60, 54x24, 18x30
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22x52", 36x48", 42x48", 20x24", 15x36"
DISC CRUSHERS, 48", 36", 24", 18"
OIL ENGINES
50-75-100-200-500-650 H.P.
3—3½ YD. SHOVELS
2—200 H.P. MOTORS S RING
440 v., 60 cy., 3 ph., 435 rev., G. E.
Ross Power Equipment Co.
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DUMP CARS
50—4-yd., 36" gauge, WESTERN, 2-way side Dump, new 1923. Heavy Duty, 4-pedestal, STEEL DRAFT BEAMS Box Girder Doors; re-built like new.

STEAM SHOVEL
1—OSGOOD HEAVY DUTY, full revolving. Shop No. 1124; new late 1923, ALL STEEL CATERPILLARS, A.S.M.E. boiler; ¾-yd. dipper; HIGH LIFT; Boom Hoist; slightly used, overhauled, like new.

CRANE
1—20-ton, 8-wheel, OHIO, Locomotive Crane, Shop No. 3631, new late 1924, A.S.M.E. and Mass. Boiler; 50 ft. boom; bucket operating; M.C.B. trucks; used 4 months, guaranteed perfect condition.

GREY STEEL PRODUCTS COMPANY
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BALL MILLS, TUBE MILLS, DRYERS, BURRSTONE MILLS, PULVERIZERS AND CRUSHERS OF ALL KINDS

If you have any idle equipment, now is the time to turn it into cash.

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The Rock Plaster Corp. of New York Authorizes Us to Offer the Following Buhr Stone Mills

Three 30" Horizontal Munson Mills, Belt Driven.

Two 42" Horizontal Munson Mills, Gear Driven.

Three 36" Vertical Sturtevant Mills, Belt Driven.

Guaranteed Good Operating Condition.

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STEAM SHOVELS
1—Model 60 Marion.
1—Model 70 Marion.
CRANES
1—18-ton O. & S.
2—20-ton Brownings.
2—30-35 ton McMylers.
1—30-ton Ohio.
CARS
40—12-yard Western Air Dump.
10—16-yard Western Air Dump.
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2—7-ton Fate Gasoline, standard gauge.
2—55-ton, six-wheel switchers.
4—18-ton, 36" gauge Vulcans.
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Harry Kleinhans Company
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CRUSHERS
1—36"x48" Traylor Jaw, managanese fitted.
1—24"x36" Farrell Jaw.
1—No. 8 Superior McCully gyratory.
3—Symons Disc 48"—36" and 18".
1—No. 5 Austin gyratory.
1—No. 3 Traylor gyratory.
1—9"x15" Farrel, mounted on trucks.
1—No. 4 Gates, standard drive.
SHOVELS
1—Model 103 Bucyrus, cat. also R. R. trucks.
1—Marion Model 37, caterpillar.
1—Northwest Model 104, combination crane.
1—Marion Model 28, combination crane.
1—Marion Model 31, caterpillar, 1 yd. bucket.
CRANES
1—Browning 30 ton, 55 ft. boom.
1—O. & S. 22 ton, with 50 ft. boom.
1—O. & S. cat. gas, 40 ft. boom, 10 ft. ext, 1 yd. bucket.
1—Austin No. 5, combination dragline.
BOLL MACHINERY COMPANY
140 So. Dearborn St., Chicago, Ill.

FOR SALE

1—Sauerman Slackline Cableway Excavator, 2-yd. capacity, 110 ft. Steel Mast, Clyde Double Drum Engine and Boiler Complete and practically new.

1—50-ton American Locomotive Standard Gauge.

1—200 H.P. Scotch Marine Boiler.

THE M. A. CALLAHAN CO.
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FOR SALE

2—Davenport 40 ton, saddle tank locomotives, just thru shops.
1—Bucyrus, 20B, caterpillar steam shovel, ¾-yd. dipper.
1—Marion Model 31 steam shovel on caterpillar, 1 yd. dipper.
1—O&S Loco. crane, 18 ton, 55' boom, 1 yd. bucket.
1—Erie crane, 36' boom with ¾-yd. bucket.
1—70C Bucyrus R.R. shovel, just thru shops.
1—Thew steam shovel, No. 2269, road wheels, late model, high lift with ¾-yd. dipper.
2—Plymouth locomotives, 24" ga.

DOLAN-TUCKER-SMITH EQUIPMENT & SUPPLY COMPANY
53 W. Jackson Blvd., Chicago

CRANES—DRAGLINES—SHOVELS

OHIO 30-T Loco. Crane, 50′ boom, Clamshell.
BUCYRUS 50-B, Cat. with dragline equipment.
MARION 37 rigid crawling, 1¾-yd. dipper.
MARION 21 Cat., ¾ yd., 20′ boom.
(Shovels late models—Nos. near 5000.)
MONIGHAN 3-T, 80′ boom, 2-yd. Diesel.
BUCYRUS Class 14 and 24 Steam Draglines.

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AMERICAN wood stiff leg, 80′ boom. Clam.
TERRY steel guy, 115′ mast, 100′ bm. 15- T.
MEAD-MORRISON No. 103 D. D., 80 HP Elect.
MEAD-MORRISON No. 743, 3-D, 80 HP Elect.
AMERICAN D.D., 40 HP., Electric.
AMERICAN and MEAD-MORRISON Elec. Swingers.

CABLEWAY

SAUERMAN 1-yd. outfit, steam, used 90 days.

SAND AND GRAVEL PLANTS

(Will sell items separately.)

1-yd. Elec. Cableway Outfit. Pumps, Pipe, Screens, Bins, Elevator, Motors, Crusher.
Also River Plant including Dredge Boat, Tug Boat, 6 Barges, Engines, Etc.

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Including Crushers, Screens, Conveyors, Elevators, Compressors, Drills, Drill Sharpener, Locomotives, Cars, Boilers, Engine, Hoists, Derricks, Pipe, Pumps, Etc.

ALEXANDER T. McLEOD
First Nat'l Bank Bldg. CHICAGO, ILL.

FOR SALE

25—Hoisting Engines, Steam, Gasoline and Electric.

10—Air Compressors, Steam and Gasoline, and Belt Driven.

15—Pumps, Steam, Gasoline and Electric.

1—125 H.P.; 1—150 Scotch Marine Boilers.

1—30 H.P.; 1—60; 1—70 Vertical Boilers.

1500 NEW STEEL TACKLE BLOCKS, single, double and quadruple, AND SNATCH BLOCKS, all sizes at half price, manufactured by the AMERICAN HOIST & DERRICK COMPANY.

Mertes Machinery Co.
246 Oregon St.
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Hyman-Michaels Co. Offers Another HOIST Bargain

Exceptional Purchase Places Nationally-Known Lidgerwood and American Hoists on the Market

Less than one-quarter the regular price—that is our offer on these hoists. We bought them at a big reduction from their real value, and to dispose of them quickly we will sell them at

$195 Each, While They Last

Both the 7x12 Lidgerwood and 8¼x8 American Hoists offered here are of the Two-Cylinder, Single-Drum type, with reverse throttle, single geared; hoisting capacity 5,000 and 10,000 lbs. For hoisting and pulling in mines, construction work, etc.; for use on ships, tugs, barges; for skidding, swinging, car pulling, etc., nese hoists are in constant demand. Our special bargain price while they last is only *$195.00 each, f. o. b. nearest shipping point.* These hoists will be loaded from Chicago or St. Louis.

We also own and offer complete stocks of New and Relaying Rails, First-Class Locomotives, Ballast Cars, and a full line of Flat, Box, Refrigerator and Steel Hopper Bottom Cars and Cabooses in excellent condition and at attractive prices.

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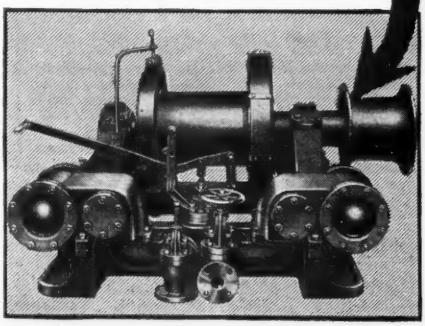

WINTER BARGAINS—CRUSHERS

1—N. 9 and 4 Telsmith Plant Complete.
1—No. 20 Superior type McCully used few mos.
1—No. 12 Gates Style K extra parts.
1—No. 9 Gates Style K with manganese fit.
1—No. 8 Gates Style K used two years.
2—No. 7½ Gates Style K used five years.
2—No. 6 Gates Style K used six years.
1—No. 5 Gates Style K. New.
1—No. 4 Gates Style K, manganese fit.
2—No. 3 McCully in perfect condition.
1—42x48 Allis-Chalmers Jaw Type mang. fit.
1—24x36 Farrell Style B mang. fit.
1—30x36 Farrell Style B mang. fit.
1—36" Symons Disc Crusher style C with parts.
1—Symons 48" Style C; A-1 Condition.
1—Symons 48" Vertical Brand New.
Also others of smaller sizes. I have Elevators, Screens, Hoists, Cars, Cranes, Compressors, Draglines, Blast Hole Drills, Track and all other Quarry Equipment to go with above.

GEORGE C. MARSH
1612 Great Northern Bldg. Chicago, Ill.

FOR SALE CHEAP

1—20/25-ton Industrial locomotive crane D.D. A.S.M.E. boiler, 8 wheel. Can be seen in operation now.
1—D.D and swinger electric Hoisting Engine, with 25- or 40-hp. motor, Hayward holding drum.
1—D.D. Meade-Morrison hoist eng. 8¼x10 skeleton.
1—¾-yd. Haiss Clam Shell Bucket.
3—Stiff Leg Derricks; bucket operation.
1—Hayward 4-Leaf O. P. bucket, ¾-yd. cap. New.
1—No. 9 Cameron Steam Pump.
1—Lidegrwood D.D. Hoisting Engine. A.S.M.E. boiler 8¼x10 in., new 1924—used 2 mos.
1—Vulcan 26-ton Std. Ga. 12x16 S. T. locomotive.
300-ton 67½-lb. rail—relaying.
2—14-ton, 36-in. ga. Baldwin locomotives, S. T.

HARRY C. LEWIS
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DRYERS—CRUSHERS GRINDERS—PULVERIZERS

NEW—For All Purposes—USED
Plants Designed and Equipped

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90 West Street New York City

FOR SALE

1 complete Sand and Gravel Dredging and Washing Plant, consisting of ½ yd. Sauerman drag line excavator, Austin Crusher, Rex Washer, Acme Screen, with both steam and gasoline engines and electric light plant. All Cables, Mast and storage bins. Address Box 24, Pit and Quarry, 538 S. Clark St., Chicago.

FOR SALE

Model 60 Marion Steam Shovel, R.R. trucks, 2½ yd. dipper, located Delaware, Ohio. Rebuilt at cost of $3,500.00, and not used since. Bargain price.

Estate of A. T. Baldwin
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FOR SALE

Hopper Cars—Steel 40-50-70 ton, new.
Loco. Crane—Brown No. 6 40 ton 60 ft. B DD.
Clam Shell—Hayward 1 yd. motor driven.
Trav. Crane 10 ton Northern A C 80 ft. 6 in. centers.
Dredge—Comb. elevator and Hyd. steel digs 40 ft.
Crushers—Draglines—Shovels—Locomotives.
Stripping outfit—(2) Bucyrus 225-B Marion 300.

A. V. Konsberg, 312 S. Clark St., Chicago

For Sale

MARION 36 SHOVEL

Full Revolving—Traction Wheels, 24' Boom, 16' Dipper Stick, 1¼ or 1½ yd. Dipper. Guaranteed first-class condition.

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2—4 Drum McMyler Shaft Hoists.
3—1-R Compressors, 1190 ft. belt dr.
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5—12 Yd. Std. Gauge Dump Cars.
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Steam & Electric Hoists, Boilers, Etc.

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For Sale—Crusher

Small Sturtevant Rotary Crusher. Priced low to avoid storage charges.

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Released Quarry Equipment

70 Ton Bucyrus R.R. Wheels.
No. 8 Superior Gyratory Crusher.
No. 5 Austin Gyratory Crusher.
2—14 Ton 9"x14" Porter Dinkies.
5 Yd. Heavy Duty Steam Shovel Dipper.
We want to move this equipment and are making prices that will do it.

LEHIGH STONE COMPANY, Kankakee, Ill.

FOR SALE AT A BARGAIN

42-inch gauge 25-ton Climax Locomotive, in use to October 1st when we changed to standard gauge. Can be inspected at Arrington, Virginia. Boiler insured for 160-lb. working pressure. Inquire

STANDARD SOAPSTONE CORPORATION
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UNUSUAL VALUES FOR QUICK SALE

2—300 H. P. Erie Water Tube Boilers, 175 lb. pressure, 135 ft. stack, first class condition $2500.00

1—Steam Plant consisting of:
2—150 H.P. Walsh and Weidner Boilers.
1—150 H.P. PJackson Corliss Engine.
1—Alternator.
1—300 H.P. Water Heater.
All fittings $2850.00

WIRE, PHONE OR WRITE
MILLS EQUIPMENT CORPORATION, 1222 Volunteer Bldg., CHATTANOOGA, TENNESSEE

Business Opportunity

A company who are anticipating liquidating their business has for sale a new and modernly equipped sand and gravel crushing, washing and screening plant, built late in 1925 and operated a few months only. Equipped of best manufacture, electric power throughout with a capacity of 60 cu. yd. per hour. Plant ideally located in one of the busiest sections of Michigan with prospects of exceptional business. Address Box 20, Pit & Quarry, 538 S. Clark St., Chicago, Ill.

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Standard Gauge

Gas or Steam, 20 to 40 ton. Send complete description, including draw bar pull of same, price F. O. B. shipping station, etc. Address Box 22, Pit and Quarry, 538 S. Clark St., Chicago, Ill.

Wanted

1—16 or 18 ft. 40 in. screen.

KENTUCKY RIVER STONE & SAND CO.
Lawrenceburg, Ky.

FOR SALE

1—No. 7½ Austin Crusher, chilled iron fitted.
1—Model 60 Marion Shovel No. 1493.
1—Model 80 Marion Shovel No. 801.
1—Model 70 Bucyrus Steam Shovel.
1—Model "O" Thew Revolving Shovel.
1—1-yd. Vulcan Revolving Shovel.

THE CASPARIS STONE COMPANY
302 Yuster Bldg., Columbus, Ohio

FOR SALE

1—18B Bucyrus Shovel, on traction wheels. Shop No. 2053.
1—No. 20 Superior Type McCully Crusher. Located Olive Branch, Ill.
1—25-ton Davenport std. ga. Saddle Tank Locomotive.

H. A. COOLEY
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WANTED

About 150 ft. of used troughing belt conveyor head and tail pieces, pulleys, idlers and belting about 24" wide.

ATLAS SAND, GRAVEL & STONE CO.
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POSITION WANTED

Quarry Superintendent, experienced in hard and soft rock and gravel, installation of equipment and repairs, wishes to connect with concern needing man with energy and who will get results. Remuneration to be governed by results. Address Box 26, Pit and Quarry, 538 S. Clark St., Chicago.

FOR SALE

120 acres best gravel lands in the west. Deep gravel beds containing fine porcelain sands. Exceptional location adjoining Mississippi River and Railroads. Write at once for further information.

JAMES HEALEY,
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Wanted—JAW CRUSHER

42"x48" Jaw Crusher, Manganese fitted; must be in first-class condition for operation. Give full details, price, and location in answer. Address Box 11, Pit and Quarry, 538 So. Clark St., Chicago.

WANTED—SCREENS

Second-hand set of rotary sand and gravel screens, also conveyor belt. 200 ft. center, capable of handling 100 tons of sand and gravel per hour.

L. A. McNAMARA
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Good Used Equipment — Hudson Terminal Bldg. NEW YORK — Clean Business Methods

Steam Shovel For Sale

Engineer original owner Marion type 21 with 20 foot boom, 16 foot dipper handle, full manganese bucket on traction convertible mounting; will sell and arrange for operation if desired.

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(1) No. 5 Austin Crusher with (2) No. 2 Gates, 50 ft. elevator, 16 ft.—42 inch screen. Commercial rock quarry. First class condition. (1) practically new No. 4 Telsmith with elevator and screen. $1400.00.
(12) No. 248 Ingersoll-Rand Drills, some new,—all in first class condition. Bargain. $50.00 each.

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